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ABSTRACT

It has become common to say that incorporating environmental education into general education mainly means integration of environmental content into the content of general, school, and higher education. This study attempts to identify, examine, and propose a system of criteria for rationally grounded selection of the environmental content of general education, particularly at the level of higher education. The two sets of criteria examined, educational and scientific, are shown to overlap and taken together, to complement one another. The study is intended to be theoretical and not to be used as a practical guide. Chapter 1 centers on the need to educate the general public and prevent environmentally harmful decisions. Chapter 2 gives a brief review of worldwide environmental conditions. Chapter 3 deals with a conceptual framework to determine the environmental content of general education, including the higher education level. This chapter also contains some reflections and considerations of ways and modalities of integrating the environmental dimension into general higher education. Chapter 4 is concerned with several global and regional environmental issues. Selection criteria are defined on the basis of the analysis of issues identified. A selected bibliography contains 73 entries. (LZ)

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PEDAGOGICAL AND SUBSTANTIVE CRITERIA FOR TEACHING ENVIRONMENTAL CONCEPTS IN SCIENCE

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PEDAGOGICAL AND SCIENTIFIC CRITERIA FOR DEFINING ENVIRONMENTAL CONTENT OF GENERAL UNIVERSITY EDUCATION

Prepared by:

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PEDAGOGICAL AND SCIENTIFIC CRITERIA FOR DEFINING ENVIRONMENTAL CONTENT OF GENERAL UNIVERSITY EDUCATION

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INTRODUCTION

Over the last two decades, environmental education has been widely discussed by experts at national and international meetings as well as by intergovernmental conferences. Its many aspects are dealt with in numerous studies and research reports. Declarations and recommendations of some of them, and conclusions of others, have contributed to significant progress in the conceptualization of a wide range of issues in this relatively young field, and have provided certain elements of the theoretical foundation for educational practice.

UNESCO and UNEP played an important role in stimulating efforts in such conceptualization. They have also achieved much through their own activities within the International Environmental Education Programme.

In this respect, the culminating point was the 1977 Intergovernmental Conference on Environmental Education organized by UNESCO in Tbilisi with the co-operation of UNEP. Its final Declaration and recommendations provided a sound frame of reference for practice, as well as for continued efforts in conceptualization.

The progress achieved since is considerable. However, despite the amount of practical and theoretical work accumulated over the years, some aspects of the problem, both theoretical and practical, need further elaboration.

It has become usual to say that incorporating environmental education into general education mainly means integration of environmental content into content of general, school and higher education. From existing literature it can be concluded that, with all the positive results achieved, both at national and international levels, one of the essential aspects of the phase of selection of elements to be integrated into general education has not yet received the attention it deserves. The aspect in question concerns the guiding criteria and principles in determining what in the accumulated knowledge about the environment should be considered indispensable for each member of society, particularly those who in our case, have a university degree, in other words, the criteria and principles which determine the environmental content that the higher education

system should form part of each student's educational background, irrespective of his or her specialization and future occupation. Because of the diversity of fields covered by higher education at this level, the issue merits special attention.

In general, criteria for selecting teaching material for environmental education should probably be the same for all levels of education. At the same time, application at each level, especially university or higher education, should take into consideration its characteristic features, in this particular case, the diversity of programmes offered and the level of knowledge and competence of teaching staff and students.

Certain studies completed within UNESCO programme devoted space, *inter alia*, to the concept of general environmental education at institutions of higher education, or to the criteria of content selection. But, no specific systematic study on the issue of criteria has been made to date.

This study whilst taking into account the accumulated experience and knowledge in the field, attempts to identify, examine and propose a system of criteria for rationally grounded selection of the environmental content of general education, particularly at the level of higher education. This study discusses two sets of criteria - educational and scientific - which are shown to overlap (some of them), and taken together, to complement one another.

The study does not claim to be exhaustive. Further discussion of the subject should enrich, extend and specify it, perhaps rectifying some points.

It should be emphasized that this work is a theoretical study and is not - and could not yet be - a practical guide, an application manual of normative rules and criteria; it is concerned with the determination and discussion of criteria for the rational selection and definition of the environmental content in general education, particularly at the level of higher education. Several environment issues, the consideration of which in curricula and courses is suggested by criteria discussed in this study, are also examined in order to render the discussion concrete and "visual".

The study is intended primarily for researchers in the field, syllabi (and curricula) specialists and authors of textbooks, academic and high-ranking administrative staff of colleges and universities. It is hoped that the study will stimulate further theoretical work and new studies on one of the most important aspects of the advancement of general environmental education at the higher education level. We also hope that this study, though not yet a practical guide, will nevertheless prove useful for rational selection of elements of environmental content and their subsequent integration into general higher education.

The study consists of four chapters. Chapter 1, "The imperative of environmental education", centres on the vital need to educate the general public so as to impress on them the necessity to protect and improve the environment, and to prevent any environmentally harmful decisions. Chapter 2 gives a brief review of the worldwide situation of the environment in the last decade of the second millennium, and of inherent threats caused by processes triggered off by man's own activity.

Chapter 3 and 4 concern the main subject of the study.

Chapter 3 deals with the conceptual framework to determine the environmental content of general education, including the higher education level. Having analysed the concept of general environmental education and having suggested a definition for it, the authors devote space to its role and significance in the higher education system, and go on to systematically discuss its goals, objectives and principles concluding that educational criteria for determining its content should be derived from these goals, objectives and principles. Scientific criteria are derived from various requirements of both natural and social sciences.

Chapter 3 also contains some reflections and considerations of ways and modalities of integrating the environmental dimension into general higher education. The last section deals with evaluation of the implementation of selection criteria for general environmental content in higher education.

Chapter 4 is concerned with several global and regional environmental issues. It shows the kind of knowledge that both meets the selection criteria for general environmental education, and is conducive to achieving its objectives and goals. From the standpoint of the main aim of the present study, problems and processes discussed in Chapter 4 are of special interest, since selection criteria have been defined on the basis of the analysis of these and similar problems and processes, as well as identification of some common features.

All these issues are explained in greater detail in the introductory section of the chapter in a somewhat different form.

Chapter 1

THE IMPERATIVE OF ENVIRONMENTAL EDUCATION

Ever since major international actions demonstrated the world community was aware of the urgency and vital importance for the human race for a sustained effort to preserve, defend and improve the environment, the key role of education in this area has been underlined. Held in Stockholm in 1972, the United Nations Conference on the Environment recommended that the United Nations Secretary General, United Nations bodies, including UNESCO and other international organizations take measures to prepare and implement an international interdisciplinary educational programme involving all levels of education, addressed to all categories of the population, for ordinary citizens, living in urban and in rural areas, old and young alike, with a view to familiarizing them with accessible forms of activity in which they could participate to protect and control the environment.

After widespread consultations, such a programme has been drawn up by UNESCO, in co-operation with the United Nations Environment Programme (UNEP) which, as the International UNESCO-UNEP Environmental Education Programme was implemented as of 1975.

The first stage of this programme enabled a series of events to be elaborated and undertaken culminating in the first Intergovernmental Conference on Environmental Education, held in Tbilisi (USSR), in 1977.

The Tbilisi Conference became a historic event. It summed up the first steps towards environmental education for the whole world - i.e., its initial stage for most countries - and laid the conceptual and theoretical groundwork for environmental education. The Tbilisi Declaration and Recommendation No. 1 stress that environmental education should be available for people of all ages, at all levels of formal and non-formal education, and for all social and professional groups. It should be a life-long process and should, through a constant renewal of content and methods, present a range of knowledge consonant with the evolution of the environment itself. It was also noted that the media are faced with a major task in making their enormous potential available for

this education mission (See: UNESCO. Intergovernmental Conference on Environmental Education. Tbilisi, 14-26 October 1977. Final Report. Paris, 1978. Recommendation No. 1). (For brevity's sake, the phrase "Final report of the Tbilisi Conference" will be used hereafter).

A decade later, similar ideas were formulated in a report of the World Commission on Environment and Development, known as the Brundtland Commission Report. It states, in particular, that environmental education should be included in and run throughout the other disciplines of the formal education curriculum at all levels and that adult education, on-the-job-training, television and other less formal methods must be used to reach out to as many people as possible, as environmental issues and knowledge systems undergo radical changes within the lifetime of each generation. (See: Our Common Future. World Commission on Environment and Development. Oxford - New York. Oxford University Press, 1988. p.113).

Going back to the Tbilisi Conference, it is important to underscore that it gave environmental education the status of an ethical norm by recognizing each citizen's right to it.

The 16 years that have passed since the Tbilisi Conference have demonstrated conclusively that the behaviour, actions and decisions of people of different ages, social status and socio-professional groups in everyday life and work activity can affect the environment to a greater or lesser degree. Even when, taken separately, the consequences of the behaviour and actions of individuals are of little significance, combined they may prove considerable. Lack of understanding, unpreparedness, ignorance of environmental issues and the resulting indifference and irresponsibility towards them bring about many actions with undesirable, and even disastrous, effects either locally or on a wider scale.

Lack of knowledge and understanding hampers the moulding of powerful enough public opinion, capable of withstanding environmentally irresponsible and harmful decisions and actions of enterprises and entrepreneurs, local or national authorities. In democracies with a developed civil society, strong public opinion and an environmentally aware population, both government and enterprises have to be increasingly appreciative of environmental considerations and to the

response of citizens to decisions that might be harmful to the environment. This compels them to provide for special measures, to work out technological solutions and facilities which rule out or significantly diminish any adverse environmental effects of their policies. An ecologically ignorant population, or a population that is poorly or partially informed, an underdeveloped civil society, lack of accountability to the population of the different authorities may allow the latter to treat irresponsibly, or even ignore, the environment in a bid to ensure immediate economic and/or other efficiency. It can be safely assumed that if anything on the scale of the Chernobyl disaster took place in an advanced western country or in Japan, the population and the authorities would have behaved in a way that would have ultimately resulted in far fewer victims than there were in the former USSR, because of the lack of knowledge and understanding, inadequate information, not to say disinformation, of the population and the irresponsibility of the authorities at different levels.

The years since the Tbilisi Conference have confirmed the need for general and life-long environmental education. Whilst underlining this, it should be borne in mind that the nature, volume and orientation of such education would differ according to people's activity and their belonging to this or that socio-professional group.

The Tbilisi Conference recommended three basic types of environmental education and suggested three major target categories at which each of the three types should aim. One is the education of the general public, which should be made available to people of all ages, schoolchildren, college and university students, young people and adults, as part of out-of-school education. In the latter case, voluntary organizations are called upon to play a major role.

Another is the education of specific occupational groups whose activity significantly influences the environment. This includes, for example, engineers, architects, urban experts, administrators (managers), planners, industrialists, policy-makers, farmers, etc. They are to receive the necessary training through both formal and non-formal education.

And, finally, the third type of environmental education is the training of researchers and specialists dealing specifically with environmental issues: biologists, ecologists, hydrologists, agronomists, forest rangers, landscape architects, oceanographers, meteorologists, etc.

The UNESCO-UNEP International Congress on Environmental Education (Moscow, 1987) held ten years after the Tbilisi Conference, reiterated the same concepts in a somewhat modified form. Having recalled in its International Strategy of Action in the Field of Environmental Education and Training for 1990s that this education should, as the Tbilisi Conference ruled, be integrated into all educational activities and addressed to all categories of the population, the Congress defined these categories in the following way:

(1) the general public and non-specialists;

(2) socio-professional groups whose activity has repercussion for the environment;

(3) scientists and technicians in fields connected with natural and social sciences that deal with the environment. (See: Stratégie internationale d'action en matière d'éducation et de formation relatives à l'environnement pour les années 1990. Nairobi - Paris, UNESCO-UNEP, 1988. p.2, para. 4).

This study concerns the issues dealing with the definition of the environmental content of general education, in particular, in higher education, i.e. the content that should be **common** for all, leaving aside specific elements intended either for the second, or for the third group, and which is addressed to all, which is **universal**. In this sense, it refers to all three categories (groups). But, it can also be said to concern the first to the extent to which this group covers everyone, including those who subsequently make up the second and third groups, and that the specific matters designed for groups 2 and 3, far from excluding general environmental education, proceed from it and branch off, as it were, by way of continuation.

Chapter 2

AN IMPENDING DISASTER

Global environmental problems emerged recently. Experts agree that they can be traced back to the middle of the century, when, following World War II, the rapid development of the world economy was first experienced. There had been local environmental crises, and even disasters, before; however, they had no significant impact on the biosphere of the planet as a whole.

Environmentally, the essence of the changes that have been taking place lies in the fact that the ecosystems of the earth, and its biosphere as a whole, can no longer withstand anthropogenic effects, nor can they make up for these effects or regenerate completely to the original state. The human environment is changing in a way and at a pace that it becomes dangerous for the health and very survival of humanity.

Far from all of these changes have been timely recognized by science; thus, the depletion of the earth's ozone layer was discovered only in the mid-80s, when it had gone too far.

Quite possibly, some ecologically relevant facts are not known even to this day. Consequently, extremely harmful activities have become increasingly widespread: extensive use of DDT and other pollutants in agriculture had long been regarded as beneficial; chlorinated substances had been applied to an ever greater extent in industry and daily life destroying the ozonosphere. Meanwhile, the general public's awareness of environmental issues disastrously lagged behind the understanding of these issues by scientists. This was largely due to the standoff of the two opposing military political blocs (the danger of a new world war overshadowing in the minds of people the warning signals of other dangers), ideological barriers (these are, allegedly, typically "their" problems, there can't be anything like this at home), the classified nature of environmental information in many parts of the world, its inaccessibility for those who were not "privy" to closely guarded "secrets", and so on.

For these and very many other reasons, such as the high cost of nature protection, other competing priorities, the series of measures taken to environmental destruction still bears no comparison to the accelerating destructive processes. The world is riding for an environmental fall. Only the world community as a whole can prevent catastrophe, and this on condition that all countries pool their efforts, and the major industrial nations shoulder the huge expenditures required to normalize the world environment.

Today, the acuteness of environmental problems, and the rapid movement towards an environmental disaster are, as far as we know, beyond doubt in professional quarters, as attested by the flood of works published by scientists, journalists and educators in the past few years. Since ecology as a science, or a system of sciences, is going through a period of explosive development, scholars disagree on many specific matters (on some points they may even be opposed); however, there is complete agreement in the assessment of the current situation and the trends of environmental change.

In 1983, the United Nations set up the World Commission on Environment and Development (22 members representing 21 countries) which carried out an enormous amount of work to summarize the huge volume of scientific and factual evidence accumulated by the mid 80s on the state of the environment and its development. Published by this Commission (the Brundtland Commission) in 1987, the Report "Our Common Future" seems to provide a most balanced reflection of environmental reality and its possible change, containing the most complete, concentrated assessment of the state of the environment and the general course of its development as of the mid 80s.

Dangerous trends are at work in the sphere of the environment. They may radically alter the planet, they threaten the existence of many species, including humankind. Each year 6 million hectares of productive dry land becomes worthless desert. More than 11 million hectares of forest are destroyed yearly, a considerable part of which is turned into poor quality farmlands, unable to feed the farmers living on them. In Europe, acid rainfall kills forests and lakes and damages the artistic and architectural heritage of nations; it may have acidified vast tracts of soil beyond

reasonable hope of repair. Fossil fuel discharge carbon dioxide in combustion into the atmosphere, causing gradual global warming, resulting in a global "greenhouse effect" which may raise average global temperatures by early next century. The consequence will be to shift agricultural production areas, to raise the sea level to flood the coastal cities and disrupt national economies. Other industrial gases threaten to deplete the planet's protective ozone shield to such an extent that the number of human and animal cancers would rise sharply and the ocean's food chain would be disrupted. Industry and agriculture discharge toxic substances into the human food chain and into water tables beyond reach of cleansing. (See: Our Common Future, pp. 2-3).

Of course, this mild description of the deplorable present and possible future state of the planet's environment is far from complete, as transpires from the Brundtland Commission report: there is no mention of the rapid disappearance from the face of the earth of a great many biological species, the erosion of ecosystems and more. Scientific literature contains many more severe descriptions of the state of the environment and its development trends.

The World Commission on Environment and Development was assigned three objectives:

to re-examine the critical issues of environment and development and to formulate realistic proposals for dealing with them;

to propose new forms of international co-operation that would influence policies and events in the direction of needed change; and

to raise the levels of understanding and commitment to action of individuals, voluntary organizations, businesses, institutions and governments. (Ibid., pp. 3-4).

The aim of this study virtually coincides with the last objective of the Commission. At present, levels of ecological awareness can be heightened only through an across-the-board introduction of environmental education in universities and other institutions of higher education. Preparing ecologically competent specialists in universities, teacher-training and vocational colleges is the precondition for a sound environmental education at all pre-university levels, for

effective practical activity to gear all types of material production to environmentally safe recycle and low-waste technologies, for the correct orientation of voluntary environmental movements, for the drafting of optimum environmental policies, both nationally and internationally.

Most people directly perceive unfavourable environmental changes, but as a rule fail to realize their causes, especially global ones; in many cases, they see the immediate causes of local change, but are unaware of those which are more remote, more important and fundamental, the "causes of causes".

University environmental education should, *inter alia*, provide an understanding of the global laws of environmental change largely determined by the factors that govern them.

It is important to recognize the close relationship existing between the current environmental crisis and rapid population growth, coupled with the huge expansion of industrial production.

Since the beginning of this century the population of the world has trebled, growing particularly rapidly after World War II. Although the growth rate has recently decelerated, the "demographic explosion" has not stopped yet. Even if the per capita consumption of the earth's natural resources remained unchanged, the anthropogenic pressure on the biosphere would increase threefold. In reality, however, per capita consumption is growing at a fast pace. According to the Brundtland Commission report, "industrial production has grown more than fiftyfold over the past century, four-fifths of this growth since 1950". (Ibid., p. 4).

The future state of the environment greatly depends on how fast both world population and industrial production will develop.

Scholars agree that, in the near future, the earth's population will continue to grow at a fast, if a slackening pace, whilst industrial production will evolve much faster than the population.

Most demographers engaged in forecasting believe that the world's population will number 10-12 billion people in the next century, i.e. it will at least double, after which it will cease growing. The percentage of urban dwellers will rise sharply; at present, they account for one third

of the world's population, by the year 2000 they will make up one half. In the twenty-first century nearly all population growth will be in the cities. And, a city-dweller consumes far more natural resources and produces far more environmental pollutants than a rural resident; a rural dweller's vital function wastes join the natural circulation of substances to an incomparably larger degree.

Industrial production should grow much faster than the population. "Given population growth rates, a five- to tenfold increase in manufacturing output will be needed just to raise developing-world consumption to industrialized world levels by the time population growth rates level off next century". (Ibid., p. 15).

But, on the other hand, "threats of global warming and acidification of the environment most probably rule out even the doubling of energy use based on present mixes of primary sources". (Ibid., p. 14).

From this comparison alone can be seen the complexity of the tasks facing humanity. Global environmental problems cannot be solved without simultaneously resolving those linked to the economy. In point of fact, what humanity is up against is an ecologo-economic centaur, so closely interwoven are the issues of the economy and the environment.

In reality, the situation is far more complex. There is no reason to believe that the population of the industrialized countries will be content with current standards of living in the future. Although the probability that the planet's population will not go beyond the 12 thousand million mark is rather high, it cannot altogether be ruled out that this figure will be exceeded. If humanity sticks to traditional fossil fuels, it is likely to make much greater use of coal, which is environmentally more pollutant, since oil reserves are being quickly depleted.

The switch-over of the world's industry to energy-saving technologies is inevitable. The potential of fuel saving is fairly high, as demonstrated in the 70s and 80s, when energy saving was particularly stimulated by the energy crisis; none the less, it is incommensurate with the world's growing energy needs.

Hopes vested in nuclear power have proved to be exaggerated. Accidents at nuclear power plants, the realization of the difficulties inherent in storing radioactive wastes and residual reactor fuel and, dismantling unoperational reactors, vanishing illusions about the alleged efficiency of nuclear power plans have decreased the promising prospects of nuclear power engineering. The introduction of new capacities has slowed down sharply. Such an authority on nuclear matters as Dr A. Sakharov believed that, proceeding from environmental considerations, only subterranean nuclear power plants should at present be built. But, clearly, they would be much more expensive than ground facilities and, therefore, less competitive.

A few decades ago much hope was pinned on the future of nuclear power engineering. It was expected that nuclear fusion would be achieved and used in commercial power engineering at a comparatively early date, enabling humanity to solve the energy problem once and for all. However, the problem proved to be much more complex.

On a worldwide scale, most energy is obtained through the combustion of fossil hydrocarbons. The reserves of natural fuels, especially coal (unlike those of oil) are great, which makes it possible to intensify their combustion many times over. Environmentally, however, this is out of the question. In principle, it is possible to neutralize completely, or almost completely, ashes and nitric and sulphuric oxides forming atmospheric acids which cause acid rains that destroy biocoenoses. However, it is quite impossible to neutralize carbon dioxide, whose accumulation in the atmosphere generates the greenhouse effect which, in turn, is responsible for a higher global temperature and world ocean levels.

In all probability, humanity will find a solution to this and other environmental problems. But, what is even more likely is that future generations will have to be very economical, deliberately limiting production and consumption for the sake of a more or less healthy environment. In point of fact, this will be a matter of the survival of humanity. Outlay on environmental protection will sky-rocket, and these costs will have to be shouldered by those who destroy the environment, by and large the industrialized nations. Quite possibly, taxes will be

eventually levied on facilities producing environment-hostile industrial wastes, particularly carbon dioxide.

During the years following the session of the World Commission on Environment and Development the world situation has developed along much the same lines, i.e. has deteriorated.

Obviously, the environmental situation differs greatly from one part of the world to another. In some parts of the globe it is still quite favourable on the whole, in others it is improving somewhat (in urban Japan or in Germany's Rhineland), in still others it is precipitously moving towards ecological disaster, while some territories and parts of the world ocean are experiencing environmental crisis.

Thus, in the past few decades, the environmental situation in the former Soviet Union, whose territory accounts for one sixth of the world's populated territory, has rapidly been worsening. Many parts of the former Soviet Union are experiencing an environmental crisis, some regions having gone through environmental disasters (the Chernobyl area, the Aral area, some parts of the Southern Urals).

Leading national ecologists regard the current environmental situation as critical, bordering on, and fast approaching disaster. Here is how the situation is summed up by an eminent Russian ecologist whose views are far from extreme.

In the opinion of the noted scientist A.V. Yablokov, the environmental situation in the former USSR "has recently been deteriorating with every passing year. Perestroika has not changed the dangerous trends in the environmental situation. Five years ago we thought that this was the limit. It turned out that it wasn't ...".

Wherein do the causes of the environmental crisis in the country and in the world at large lie? According to A.V. Yablokov "the reference to the inevitability of environmental problems resulting from the development of industry and the national economy is untenable". (A.V.

Yablokov. Ekologičeskoe nevežestvo .... In: Inogo ne dano". Moscow, Progress Publishers, 1988. p. 241).

Having cited ten dramatic examples of environmental degradation in the former Soviet Union, the author draws a general conclusion: the resolution of environmental problems is impeded by:

"environmental ignorance;

environmental shortsightedness;

environmental adventurism;

environmental immorality" (Ibid., p. 251).

Among these interrelated, if somewhat autonomous causes, environmental ignorance tops the list.

This is exactly why full-blooded environmental education of specialists (non-ecologists), as well as the general public, and sound, readily available environmental information are so important.

Chapter 3

CONCEPTUAL FRAMEWORK TO DETERMINE THE ENVIRONMENTAL CONTENT OF GENERAL HIGHER EDUCATION

(The concept of general environmental education; the goals, objectives and principles of general environmental education and the criteria to determine its content for higher education: pedagogical criteria, scientific criteria; ways of integrating environmental content in general higher education; evaluating the realization of the criteria.)

3.1 The concept of general environmental education

Summing up the experience accumulated by 1977, and based on the materials made available to it, the Tbilisi Conference drew up a fairly coherent concept of environmental education as regards its goals, objectives and principles, as well as a series of guidelines concerning ways and modalities of implementation. In the main, this concept also relates to environmental education within the framework of higher education. Time has shown that, basically, it remains valid. The 1987 Moscow Congress confirmed it by recommending the previously-mentioned International Strategy of Action which is based on the concept adopted at the Tbilisi Conference.

This concept has general theoretical relevance for the consideration of questions of immediate interest to this study. It is, therefore, important to analyse and, possibly, specify and further elaborate some of the definitions and ideas it contains which, in some cases, are supplemented and more clearly worded in the documents of the Moscow Congress.

According to the Tbilisi Conference, environmental education stems from the reorientation of various disciplines, and the establishment of links between them, to facilitate an integrated and comprehensive perception of environmental issues and to encourage more rational actions to satisfy the needs of society. (Final Report of the Tbilisi Conference, Recommendation No. 1). The International Strategy adopted by the Moscow Congress defines the place of environmental education in education as a whole and specifies its practical character and the nature of activity it

is called upon to prepare for. It states that environmental education represents a dimension of the content of education and of educational practice aimed at solving concrete environmental issues thanks to the interdisciplinary approach and active and responsible individual and collective participation of people. (See: Stratégie internationale d'action ... Première partie, para. 3).

This definition is supplemented by another idea in the same document: that environmental education is a lifelong process in the course of which individuals and groups of people acquire an awareness of their environment, together with knowledge, values, skills, experience and will, which enable them to act individually and collectively to resolve the current and future environmental problems (Ibid., para. 12).

Proceeding from the ideas contained in these definitions, supplementing and further elaborating some of them, it is possible to define environmental education as a salient and organic part and an essential dimension of lifelong education, which drawing on natural and social sciences, as well as the humanities and respective disciplines, on their links and interaction and, thus, being interdisciplinary in its nature and content, provides the necessary and constantly renewed knowledge conducive to a comprehensive perception of the environment, its complex, integrated nature, with an accurate appraisal of its state and problems. It promotes shaping environmental awareness, a moral stand, a sense of responsibility, skills and behaviour, and encourages people to acquire experience and take an active part individually and collectively in the preservation and improvement of the environment, in preventing and solving its current and future problems, and, where possible, in the dissemination of environmental knowledge and ethical norms.

We do not regard the definition suggested as either exhaustive or optimal. Like any other definitions, it can be supplemented and improved in substance and form. We proceed from the assumption that, usually, a definition singles out first and foremost those aspects of an object, phenomenon or process which constitute the object of investigation.

3.2 The role and significance of environmental education in the system of higher education

In the conditions current today a measure of environmental knowledge is essential for virtually everyone.

The activity of some people affects to varying degrees the state of the environment, whilst the activity of others determines people's world outlook, (including their outlook on the environment). Most, however, have to reckon with the environment in the interests of their own health, that of their family, the preservation of favourable conditions for the life of this and future generations.

People have always had ideas about the environment, though, usually, of course, at the level of common sense. To a large extent, these notions underlay the rules and conditions of hunting, fishing, gathering wild herbs, agricultural work. Quite often, environmental considerations have served as important foundations for various taboos connected with economic activity. For instance it is prohibited to start hunting one or another species of animal before certain dates, to herd cattle out the fields before they dry, to fish at a certain time, or with specified fishing tackle, etc. The rural population which was until recently prevalent, used to live in peace and harmony with nature and was well adapted to it. Man's activity fitted into the natural processes, their scale and pace. The products and waste of human activity were organically incorporated into the infinite circulation of matter and energy, without disturbing the natural balance. Things are very different now.

The population has grown considerably, a large and rapidly growing population lives in cities, away from "the land", the countryside, a natural human environment, man's natural medium of habitation; the scope of industrial and agricultural production has increased manyfold; thousands of hitherto unknown substances have appeared; the quantity of waste produced by man has acquired such proportions that nature cannot cope with its volume; we witness the radioactive

contamination of the environment and its poisoning (a novel phenomenon with a history of less than half a century) and to chemical pollution.

On the one hand, the planet is being plundered. A huge amount of a variety of substances is being extracted from the natural environment, including those which cannot be renewed; for instance, in the space of a year much of the fossil fuels (oil, natural gas and coal) that nature has taken millennia to create are used.

On the other hand, destruction of the biocoenose and the global biosphere of which man is part is underway; the conditions of our natural environment are changing in such a way that we have neither the time nor the ability (as in the case of radioactive radiation) to become acclimatized or adapted to it.

To prevent destruction, humanity must modify its behaviour in nature, its environmental behaviour, to work out and realize a new strategy of existence and, even, survival.

As has been noted, many of the current environmental problems have been caused primarily by environmental ignorance, by lack of knowledge of what consequences this or that technological or organizational decision may entail.

This may be illustrated in particular by:

heavy radioactive pollution of large areas in the South Urals in the '40s and '50s, when radioactive wastes were dumped into water reservoirs and drains;

the construction of a pulp and paper plant on the shore of Baikal, the world's biggest fresh water lake, which had a disastrous effect on its unique wild life.

Broad public awareness of environmental threats has been very late in coming. It started to gather momentum only when many big, though "local", environmental disasters occurred (those already been mentioned, and a number of others in the former USSR, the pollution of the Great Lakes in North America, the rapid desertification in sub-Saharan Africa, and so on), but

fortunately before major global disasters took place. One of the main reasons for this decades-long delay in an awareness of environmental problems was, without a doubt, environmental ignorance on the part of the general public, and a dearth of environmental knowledge at the disposal of specialists.

The general introduction of environmental content and disciplines in the curricula of higher educational institutions and universities, in particular, is sure to raise the level of environmental awareness amongst both specialists in various fields of human activity, and the general public.

The global aim of the widespread introduction of environmental content and/or environmental disciplines in the curricula of colleges and universities would be the universal dissemination of environmental perspectives and ways of thinking which, apart from environmental experts, is currently typical of specialists dealing in one way or another with biocoenoses: biologists, geographers ....

This ultimate goal seems difficult to attain in the near future, but, it is desirable that it be approached as closely as possible.

The study of environmental problems at university level should serve as the foundation for environmental education and the upbringing and training of new generations. Some elements of environmental knowledge should be part of the syllabi of general education and traditional school "subjects": biology, chemistry, geography, etc. There are advocates who support the inclusion of environmental disciplines in school curricula in a series of school subjects. They point out, not without reason, that ecology possesses a high educational value precisely as a general education "subject".

Writing good syllabi and textbooks on ecology, reviewing the syllabi and textbooks in traditional subjects from the environmental angle and, to some extent, permeating these traditional courses with environmental content, "environmentalizing" these disciplines, requires a fairly high level of environmental education for the authors of syllabi and textbooks. For environmental knowledge to become part of school education and be given adequate space in it, for institutions

and officials adopting decisions on school matters to fully understand the present and future role of the environment in life, government decision-makers, school principals, members of school councils should have the appropriate knowledge. Finally, adequate environmental knowledge for children and teenagers can only be provided by those teachers who have a good knowledge and understanding of the environment.

A reasonable environmental training for such a wide range of people can be provided only at institutions of higher education, above all universities. In many cases, it will necessitate a higher level of training than that received by university graduates, i.e. postgraduate level and subsequent research activities

Moreoever, it should be borne in mind that children receive (or do not receive) informal environmental education within the family, which is traditionally handed down from the older to the younger generations. It is quite possible that as regards the development of environmental ethics, the influence of the family on children and teenagers may be more important than formal education. Since the percentage of university graduates among young people is rapidly growing, the importance of the scope and quality of environmental knowledge and orientations provided by institutions of higher learning for the development of environmental ethics is likewise rising. The likelihood that the children of environmentally competent parents will also be environmentally competent and moral is greater than in the case of environmentally ignorant parents.

For those who, after graduation, are involved in practical activity in industry, agriculture, commerce, etc., environmental training is intended to provide a more correct and confident orientation in the business world, to enable them to adopt well-founded practical decisions (for instance, which fertilizers and herbicides should be used and how, whether plants should be protected chemically or biologically, how to secure a decrease of environmentally dangerous wastes, etc.), as well as those concerning the involvement of environmental experts in dealing with specific practical tasks and carrying out expert examinations of projects, etc.

It should be borne in mind that a considerable number or decision-makers at various levels and who, consequently, exercise great influence on very many people, are university graduates. It should also be remembered that people having had higher education make up the majority of authors of books, articles for journals and magazines, texts for radio and television, thereby participating in shaping the views of millions of readers of books and periodicals, and scores of millions of television viewers and radio listeners, and in moulding public opinion. Moreover, since higher education enjoys a certain prestige, the views and behaviour of those having benefited from higher education exercise an appreciable, though not always noticeable, influence on the everyday lives of the general public.

It can thus be said that university graduates exercise a multiplier effect, and that the integration of the environmental approach into the content of higher education will exert an environmentally-sound influence over a number of people far exceeding the numbers of those immediately involved in higher education itself. This is one of the reasons for the utmost importance of introducing environmental content in general higher education and especially education at the university level.

It is now absolutely clear that many past environmental blunders having adverse effects on our lives derive from environmental ignorance. It was for precisely this reason that polluting facilities in many cities were sited in totally inappropriate areas.

The environment can now be preserved and, in many instances, improved (basically at local levels, in certain cities and towns, agglomerations and restricted regions) perhaps only on the basis of in-depth knowledge of environmentalists, broad dissemination of environmental literacy amongst specialists in other scientific disciplines and practitioners, as well as a high prevalence environmental ethics in society.

It must be fully realized that the environmental interests of individuals and humanity as a whole are at present more important than any others, that the pollution of the environment threatens the health and life of all people on earth, especially the future generations, that the earth

is the common home of all its inhabitants, and that the choice is a common future, or no future at all.

University environmental education should become the foundation or, as it were, the cornerstone of a concerted effort of the peoples of the world to preserve the environment and natural conditions worthy of all men and women.

3.3. The goals, objectives and principles of general environmental education as the basis for pedagogical criteria to determine its content for higher education

Much space in the documents adopted by the Tbilisi Conference is assigned to the goals and objectives of environmental education. A sizable part of the Declaration and Recommendations Nos. 1 and 2 is devoted to these matters. They are also dealt with, *inter alia*, in Recommendations 3, 7, 9, 11 and 13. A more systematic and differentiated treatment of the goals, objectives and principles is available in Recommendation 2 of the Conference.

The Conference laid down three goals for environmental education. The first is to foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas; the second provides for enabling every person to acquire knowledge, values, attitudes, commitment and skills required for the preservation and improvement of the environment; and the third goal is to develop new modes of behaviour of people, groups and society as a whole.

The objectives are divided into five categories: the first one is to promote the comprehension of the global environment and related problems; the second envisages the acquisition of diverse experience and basic knowledge about the environment and related problems; the third group consists in assisting social groups and individuals to acquire a set of values and of feelings of concern for the environment, and necessary motivation to actively participate in its preservation and improvement; the fourth deals with mastering competences necessary to identify and resolve environmental problems; and the fifth objective is to provide groups and individuals with opportunities to actively contribute to the resolution of these problems at various levels.

Comparing the formulation of these goals and objectives one may wonder whether an attempt should not be made to supply a more clear-cut difference between goals and objectives.

Goals and objectives. Apparently, in defining the goal or goals, it should be borne in mind what environmental education must lead to, its desired effect, what kind of qualities must be developed and inculcated within its "product", through education. In defining the objectives one should probably start from what exactly has to be done to attain the desired result, what actions and conditions are essential to secure the desired qualities and characteristics.

If the suggested distinctions between goals and objectives are accepted, then, taking into account the definitions in UNESCO documents and the discussion of the issue in specialist literature, the goal or goals of general environmental education can be defined as follows: (a) to develop, on the basis of scientific knowledge, an environmental consciousness, the understanding of links and interaction between economic, social, cultural, political and environmental factors, ability to assess the state of the environment and environmentally active moral attitudes; (b) to inculcate a sense of responsibility towards the quality of the environment; (c) to develop environmenally sound behaviour and a willingness and a readiness to participate effectively in the preservation and improvement of the environment; and finally, (d) to awaken feelings of solidarity among countries and regions to prevent and solve environmental problems.

At the level of higher education, these goals should be supplemented by another, which is to promote the understanding of what kind of environmental information is essential for those who have acquired general environmental knowledge for their professional activity; and an ability to find, request and obtain environmental information, a fairly free orientation in environmental knowledge; an ability to broaden one's environmental education.

The attainment of these goals will require that a number of objectives are tackled. These were sketched out by UNESCO in its first Medium-Term Plan, adopted in 1976. They were further elaborated during preparations for the Tbilisi Conference, and presented systematically in the recommendations adopted. Later, on the basis of research and syntheses of experience, these

objectives were adapted to various categories of students and various levels of education. Some specifications were made in the documents of the Moscow Congress.

An analysis of the final documents of the Conference, the Congress, and of specialist literature, allows us to conclude that there should be acknowledgement of the major interconnected objectives as being the imparting and acquisition of certain knowledge, and, on this basis, familiarization with certain values and principles, the creation of conditions and organization of activity participation in which makes it possible to acquire certain practical competences, habits and behaviour.

[It is quite obvious that the goals and objectives of environmental education, echoing each other in many ways, are in a sense an extension and elaboration of the ideas contained in the definition of this education suggested above. A certain measure of repetition is natural, since the objectives and goals are called upon to explain and specify the definition.]

This general description of the objectives calls for a further specification. In their turn, the objectives set down in the UNESCO documents can be elaborated and specified on a number of points.

Objectives as criteria. It can be said that the first objective consists in imparting and acquiring the kind of **knowledge** that may help to perceive and view the environment as an integral whole, both natural and man-made, to understand its complex and composite character, linked to the interaction of its physical, biological, social, economic and cultural aspects, to realize the need to protect and improve it for the preservation and advancement of civilization and the survival of humanity, to have a clear idea of the main regional and global environmental problems, as well as of the problems of one's own city, village, country, to correctly assess the unfolding environmental processes and changes and their causes, to make appropriate decisions as regards personal actions and behaviour.

Chapter 4 of this study presents a series of well-known problems and processes that characterize, at the global and regional level, the state of the environment on the eve of the third

millennium. Appropriate familiarization of students, irrespective of their chosen specialization, with these problems offers the possibility to acquire the kind of knowledge that meets the above-mentioned criteria, and that will constitute the basis for the development of personal qualities the formation of which is the goal of general environmental education.

For instance, familiarization with phenomena such as those presented in Chapter 4, Section 4.2 - Regional Problems - will contribute to making students aware of the complex and multidimensional character of the environment, resulting from close interaction of its physical, biological, social, economic and cultural aspects.

International documentation and literature justly accord top priority to the **moral and ethical** aspects of general environmental education. And indeed, if knowledge does not result in adherence to certain ethics, if individuals and groups of people do not develop moral convictions, a kind of **inner ecological categorical imperative**, knowledge alone will not determine man's behaviour, nor his active attitude towards the environment. We will return to this aspect of the problem. At this point, however, it is necessary to underscore the objective relating to a reconsideration of certain productivist values, and to work out new norms and principles, new attitudes and ways of thinking about the environment, which in their turn will determine individual behaviour in work and in daily life. These norms and principles can generate individual feelings of responsibility for the quality of the environment whilst at the level of the community, they heighten awareness of the need for international solidarity to preserve the environment. This, in turn, will be conducive to creating a favourable social climate in which international programmes can solve global and regional environmental problems.

The shaping of human **behaviour** is a lengthy process and is determined by a multitude of factors, far from all of them being caused by conscious educational activity. It is, therefore, all the more important to organize education in a way that would encourage and create conditions and environmentally positive actions as of childhood. This is a complex task, requiring imagination, tact, constant attention both on the part of curriculum developers and teaching methodologists, of those who are responsible for organization of the educational process, and on the part of the

teacher and the educator. This will only be possible where there is a broader vision of this process, going beyond traditional frameworks, to unfold not only within but also outside the educational institution so that the student is directly, and immediately exposed to the environment, thus gaining personal empirical experience in identifying and solving problems. (See on this issue the reference to the experience of the Federal University of Pará, Brazil, in Section 3.6.).

In this way another practical objective will be met - that of developing the **ability** to participate effectively in resolving environmental problems - which will also contribute to giving a practical aspect and meaning to theoretical knowledge and ethical norms imparted by education.

The third element of the triad, along with the goals and objectives that should guide the determination of the environmental content of general education, at the higher level in particular, is the principles of environmental education.

Principles as criteria. Just as objectives have much in common with goals, so do the principles with both of them, as well as with the general definition of education itself. Hence some repetitions inevitably result from the effort to reveal all to the full.

The principles of environmental education were also systematically formulated by the Tbilisi Conference. Without enumerating all of them, we can try to sum up the central ideas. According to them, environmental education pertains to the environment in all its aspects - natural and man-made, technological and social (economic, political, technical, historical, cultural, ethical and aesthetic). It should be a lifelong process, beginning at pre-school age, and continuing both at school and in the framework of out-of-school educational activities. An interdisciplinary approach is an indispensable principle, which makes it possible to treat environmental problems in their entirety. Education is called upon to ensure the consideration of environmental issue from local, national, regional and international standpoints and to help raise awareness of the need to co-operate locally, nationally and internationally in preventing and overcoming environmental problems. Education must provide first-hand experience and allow students to make their own decisions and shoulder responsibility for them. Finally, it should be structured in such a way as to

closely link the acquisition of knowledge with the development of problem-solving skills an the identification of values.

As has been noted, the Moscow Congress recognized orientation to the solution of specific environmental problems as the most important principle of environmental education.

It can be clearly seen that almost all the ideas contained in the principles have been reflected, if in a somewhat different form, in the goals and objectives. None the less, we deem it necessary to dwell upon them, since their approach complements the analysis of goals and objectives; adding the principles to them offers a more complete picture of the conceptual basis underlying the definition of the content of general environmental education.

At this point, it seems essential to focus on some particularities which must pertain to environmental education if it is to attain its goals.

The criterion of environmental ethics. Shaping environmental consciousness and ecologically active moral attitudes, fostering a sense of responsibility for the quality of the environment and a desire to participate in its preservation, developing ecologically sound habits and behaviour, be it in school, higher educational institutions or in extracurricular non-formal educational activities, call upon not only the intellect and mind, but also emotions, aesthetic feelings, and the mechanisms inherent in training of certain habits and reflexes.

It stands to reason that environmental education presupposes, first and foremost, the imparting and the acquisition of thoroughly selected and constantly updated knowledge and information necessary to understand environmental issues, and to form what can be described as an environmental outlook. In this case, education appeals to intellect and reason. But, to cultivate a definite attitude to the world around you, a definite moral sense and convictions, a commitment to the norms of environmental ethics and behaviour, knowledge and information alone will not suffice. For this, emotional spheres and aesthetic senses have to be addressed along with an emotionally active preference for some alternatives, with an equally emotionally active rejection of the opposite. Efficient environmental education also means the development of a sense of harmony

and beauty and an unerring intuition to detect acts of violence towards nature, mutilation or destruction of natural and man-made beauty, as well as of upsetting the balance - the prerequisite for the life and health of the human race, for peace and harmony between man and nature.

Poetry, literature, painting, music, architecture and history, all have a vast potential for environmental education. This potential is not used adequately, especially within the framework of higher education.

The ethical aspect is fundamental to general environmental education. There are at least two reasons for its special consideration. First, adequating the content of the education to the requirements of environmental ethics for various categories of the population is perhaps the most important criterion of relevance of general environmental education. Second, higher education is best equipped to assume a leading role in the development and dissemination of environmental ethics through the research activity of its institutions and the knowledge it imparts to the young people who will shape the prevailing views and ethical principles of their societies.

Using today's scientific knowledge and artistic heritage as a vehicle for communicating elements of environmental ethics, it should be taken into consideration that traditional cultures, the established norms of relations with nature handed down through the centuries and closely linked religious beliefs, principles, commandments, and codes of behaviour constitute an extremely rich source upon which to draw. Solicitous attitudes towards nature, its flora and fauna, that have developed through the experience of many generations and become an integral part of traditional culture are communicated to the young by the family and community in daily activities and through deliberate educational efforts to develop desirable behaviour patterns and ethical values often manifest in various religious rites, taboos, sacred rites regarding animals and natural phenomena, etc.

The process of industrialization and economic growth at any cost has eroded many traditional values and norms, including those of attitudes to the environment.

With time, the crisis linked to the erosion of these values, and the multiplying and worsening environmental disasters were recognized as a very real threat to life on Earth. As the world community became increasingly aware of the vital necessity of concerted efforts to protect and preserve the environment, the development of environmental ethics and restoration of the long-lost harmony between man and nature began to be regarded as priority tasks.

The many forms of our solicitous attitudes towards nature, are, in the final analysis, all based on a natural desire to preserve conditions for the survival of humanity and life in general, and on instinct for individual and generic survival. But, no less important is our sense of beauty and harmony, natural aversion to violence, ugliness and deformity.

Traditional ethics of our attitudes to nature and all living things is deeply rooted in religion. Environmental ethics can be traced back to different religions and religious traditions as shown; on the basis of a number of studies undertaken within the UNESCO-UNEP International Environmental Education Programme, in UNESCO-UNEP "CONNECT" bulletin, No. 2, 1991. The authors of the article note that some modern scientists argue that they often merely rediscover concepts intuitively grasped by traditional cultural world views. These concepts can be reinforced, enriched and developed by means of findings and theories of contemporary life sciences. At the same time, the authors conclude that environmental education and its ethical component not only have their roots in these cultures and religions, but their development requires that they be solidly anchored in them, with due regard for the requirements of changing, evolving and differing civilizations.

Such an approach links the development of environmental ethics directly with the very core of an individual's spiritual life and his or her most profound moral principles. With such a lofty philosophical and ethical dimension, environmental education acquires a more prominent role and significance in education in general; the interdisciplinary character of environmental education takes on a new and wider meaning.

All these considerations mean that inculcating environmental ethics based on modern scientific data, as well as on traditional cultural and religious values, is a complex affair, requiring thorough conceptual and methodological elaboration. The most favourable conditions for it, and for its teaching are offered by universities which have the necessary research facilities at their disposal and can pool the efforts of experts in different fields of knowledge. Universities are also ensured of a high enough level of comprehension of their students. If it is worked out and tested at a university, the system of developing environmental ethics will stand a better chance of success at secondary schools and in out-of-school education programmes for adults, difficulties being graded for different age groups and levels of understanding.

Finally, the role of universities, and a higher education in general, in developing and disseminating environmental ethics is all the more important in that their activity has a multiplier effect, because they provide for the training of teachers and teacher trainers.

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Another important aspect of general environmental education lies in the fact that the content of syllabi must provide for the involvement of students in actions aimed at preserving and improving the environment to develop certain habits, behaviour and practical skills. The Brundtland Commission Report highlights this concept. Pointing out that environmental education should permeate all programmes, at all levels, to strengthen a sense of responsibility towards the state of the environment, and to teach how to observe, protect and improve it, the authors of the Report state that this cannot be achieved without involving students in a movement for a better environment (See: Our Common Future, p. 113).

Full-blooded environmental education as an integral dimension of general education thus means combining classroom, laboratory and other traditional forms of academic work with practical involvement in real life situations. It is thereby capable of achieving another major general educational objective - which is not always the case - combining theory with practice, bridging the gap between the former and the latter.

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In concluding this part of the study, it seems appropriate to underline that the goals, objectives and principles considered above are common to education intended for a variety of different age and socio-professional groups. In practical terms, it means that, while formulating the content of general environmental education and syllabi, a selection must be made of materials (facts, concepts, theoretical notions and descriptive elements) and the sequence of their presentation - classroom work, extra-mural and practical activity - arranged in such a way that, taken together, they would correspond to the principles of this education and work towards meeting the objectives and achieving the goals.

Generally speaking, the most significant criterion for the determination of the environmental content of general education is that knowledge to be communicated, teaching methods and organization of the intra- and extra-mural work correspond to the goals, objectives and principles of general environmental education. Such a correlation exists if:

(a) the knowledge to be communicated to students helps them to better understand the environment as a whole, to become aware of its complex and multidimensional character and the need to protect and improve it in order to provide for present and future generations with a satisfactory quality of life, and to preserve our civilization and the human race; to acquaint students with major global, regional, national and local environmental problems and processes, and to enable them to assess environmental problems adequately so as to make responsible, environmentally-sound decisions concerning their actions and behaviour;

(b) teaching materials for environmental education help to procure a definite ethical attitude towards various environmental issues and to development environmental ethics;

(c) the educational process and extension work provide for different forms of direct observation of various environmental problems, and for participation in solving them, thus promoting the formation of relevant skills and environmentally sound behaviour.

In other words, the pedagogical criteria for the determination of the content of general environmental education particularly in higher education, are, in a sense, its own goals, objectives and principles.

At the same time it is implied that, whilst developing the content of education for specific groups, the general background of students, their age, occupation and profession, as well as the national and local specificities of the environment are taken into account. This is also pertinent to general higher education, i.e. to the content of education which is basically intended for all students in a higher educational institution, in a given city or area.

3.4 Scientific criteria

Although ecology as it is seen today is a very young science, the volume of environmental knowledge accumulated to date is quite impressive. At present, ecology is going through a period of rapid and explosive growth and development. In the words of the Russian ecologist N. Reimers, ecology today is "a global problem superdiscipline". The entirety of environmental knowledge available in scholarly papers and monographs cannot be taken in, even by an environmental expert. A careful fairly limited selection of the most valuable information is indispensable for the environmental education of specialists in other academic and professional branches.

The accumulated scientific knowledge about environmental problems, the experience and research concerning questions of general environmental education, makes it possible to highlight a number of scientific criteria to determine its content, to develop curricula, ways and means of integrating this content into syllabi at various levels.

Accuracy of knowledge. One criterion, the most obvious one, is scientific relevance and scientific authenticity of various facts, statements, phenomena, processes, and, where a concept,

theory or hypothesis is concerned, the recognition of its scientific value. As an illustration of both we can cite desertification (see: 4.2.2 - The Sahel environmental disaster); "the greenhouse effect" (see: 4.1.3 - The greenhouse effect); underdevelopment of whole regions; environmental effects of rapid population growth with mass poverty (see: 4.1.1 - The global environment and population growth); sustainable development. Among others, this criterion calls for adequate knowledge as to the indicators and processes which characterize the state of the environment, and the factors which affect it favourably or unfavourably.

It presupposes, especially at the level of higher education, a set range of "compulsory" knowledge embracing, in part, such topics as:

the rotation of matter and energy on earth;

the relationship of the earth and space (material and energy relationship between the plane and extraterrestrial space);

the notion of biosphere and biocoenoses, their main properties, their distribution on land and sea, their natural zonality;

the notion of humanity as part of biocoenoses and the biosphere;

the central notions of general ecology, particularly, the world in terms of relations between the organizer and environment ("the master and the house"),

the main directions of the impact of man and mankind on the environment and, conversely, the impact of the modified environment on humanity;

the current state of major global environmental problems (greenhouse effect, radioactive and chemical pollution of the environment, loss of genetic information, destruction of ecosystems, population explosion ...), possibilities, and ways and means offered by science to solve these global environmental problems (see: 4.1. Global Problems).

Spacial-geographic criterion. Another criterion can be provisionally referred to as spacial-geographic. It concerns the principle of selection and classification of phenomena and problems at different levels, scales, localization and significance (global, regional, zonal, national and local).

It should be noted that a phenomenon can also be of global importance when it is observed universally (though with varying intensity) or in different regions of the globe (e.g. processes causing "the greenhouse effect"), and also when it pertains to one geographical zone or a group of countries, but has global consequences (e.g. underdevelopment and poverty of whole groups of countries and regions). In much the same way, phenomena typical of not only all, or several countries, of the region, but also of a country and even one of its parts, can have regional significance and consequences. This can be exemplified by processes taking place in a certain country connected with a river flowing across several others, and resulting from the construction of dams and canals, the use of river water for irrigation or industrial purposes.

Especially serious for other countries can be the consequences of ecological disasters occurring in an adjacent or sometimes in a more distant country. And, at times, they can cross the boundaries of the region where the disaster-stricken country is situated. (see: 4.1.4 Radioactive contamination of the environment).

It has already been mentioned that general environmental education means that its content is common to all. It will be in order at this point to say that it can be common to all only when it concerns school and college students of a given locality, a given city. But, it will differ from general education in another locality or another city in what is of concern to the local specifics and problems.

Since it is desirable to provide to all students attending higher educational institutions with a certain volume and level of knowledge about global, regional, zonal, national and local phenomena and problems, it is expedient to lay out the material (facts, commentaries and corresponding theoretical issues), following, in most cases, the general educational principle from the more immediate to the more distant. Generally speaking the more immediate, in this case the local, is

more observable than the regional and, even more so, than the global. It can be immediately observed, and, therefore, have immediate emotional appeal for the student and it will be possible from the very beginning of environmental education to arouse the student's emotions, which is so very important, in developing an active moral attitude to environmental matters.

The principle "from the immediate to the distant", especially in the area under consideration, should not be treated as a dogma, the more so when dealing with academic processes in higher education. The latter is addressed to those who are fairly well prepared to tackle abstract categories and to consider phenomena not immediately observable, but none the less capable of evoking emotional response. Such phenomena can be illustrated by the disappearance of whole species of animals (see: 4.1.5 - Loss of gene pools); the mutilation of vast expanses of land, whereby thousands upon thousands of people lose their means of sustenance (see: 4.2.2 - The Sahel environmental disaster); or the prospect of flooding considerable tracts of land - as a result of rising ocean levels.

Adequate reflection of basic concepts. In selecting facts, phenomena and theoretical concepts to be included in curricula and textbooks it is important to remember that they are called upon to explain the fundamental concepts relating to the environment and, therefore to make them part of the set of concepts of the students. Hence, the system of such concepts should be acknowledged as one of the major scientific criteria to determine the environmental content of general higher education.

They have served as the foundation for the basic concepts of general environmental education proposed in a recent publication by UNEP. (See: D. Meadows. Harvesting One Hundredfold: Key Concepts and Case-Studies in Environmental Education. UNEP, Nairobi, 1989) and carried in "CONNECT" (a UNESCO-UNEP bulletin), No. 2, 1990. Without trying to sum them up, it will be in order to briefly enumerate the basic concepts.

One is levels of "being": (a) the physical planet, its atmosphere, hydrosphere, and lithosphere, governed by the laws of physics and chemistry; (b) biosphere, all living species,

governed by the laws of physics, chemistry, biology and ecology; (c) technosphere and sociosphere - man-made world, everything that is governed by the laws of physics, chemistry, biology, ecology, as well as the laws made by man himself.

Another basic concept is that of cycles, primarily biochemical cycles, recreating favourable conditions for living organisms; phenomena threatening the functioning of cycles or, because of their excessive volumes, creating non-absorbable stresses for bio-chemical processes and disrupting their normal course (hence "the greenhouse effect", the depletion of the ozone layer, the pollution of soils, water reservoirs, atmosphere, etc.).

Another basic concept is that of complex systems of universal interconnection: interconnection of elements (not only in the sense of the periodic system) composing the system, of systems between each other, etc., hierarchical interconnection, i.e. links of different strengths.

One other basic concept is that of demographic growth and of "carrying capacity", which represents the capacity determined by the restricted production of renewable resources and the number of organisms that can be sustained on that amount of available resources. It should be borne in mind that, for human life and society, "carrying capacity" is a complex and ever-changing category; it can go up or down depending on how the environment and resources are used.

The basic concepts of environmental education also include that of environmentally sustainable development. This means reasonable use and distribution of resources, development not involving their depletion, waste and destruction, the destruction of ecosystems; it also means harmony and coexistence of economic progress and the environment. Coupled with this concept is that of socially sustainable development, presupposing a fair distribution of benefits and difficulties, where priority is given to the individual rather than to production.

Finally, one basic concept is a combination of knowledge and uncertainty, ignorance of environmental consequences of many decisions taken by man.

The authors of the "CONNECT" bulletin in providing information of the system of basic concepts, make it clear that this is not a closed system, and encourage the reader to elaborate on it. One cannot fail to notice the complexity of each basic concept, which adequately reflects the multidimensional complexity of the environment and man's interaction with it. The cited set of basic concepts provides a useful guide for selecting materials and working out curricula for general environmental education. It supplements the scientific criteria mentioned earlier for determining its content in higher education.

A number of other ideas and approaches proposed by specialists in higher education and ecology immediately concern scientific criteria to determine the environmental content of general higher education. They are expressed, specifically, in the documents of the seminar on the role of the university in environmental education held in Budapest within the framework of the UNESCO-IAU (International Association of Universities) Joint Research Programme, issued in a separate volume.

Balanced biological, technological and sociological approach. Dealing with the environmental content of general higher education, the author of the background document of the Budapest seminar, Professor D. Kuenen, former Rector of the University of Leiden, notes three different points of view on this question. Some scholars, he notes, consider the biological approach, and especially the principles of nature conservation, as the central criterion. Others advance the technological approach, and look at the possibilities of reduced side effects of industrialization, while economic progress is maintained as much as possible. And, finally, still others believe that sociological factors take pride of place in environmental issues. Considering all this, Prof. Kuenen stresses that, at the university level, a balanced approach encompassing all the main problems should be recommended for environmental education. (See: Universities and Environmental Education. UNESCO-IAU. Paris, 1986. P. 17-18). Such an integrated approach seems to be the only reasonable one. If accepted, biological, technological and sociological approaches should be recognized as criteria.

Combined ecological, socio-economic and socio-cultural dimensions. Noting that the development of environmental education requires systematic criteria for the selection of its content, the author of another document prepared for the same seminar on the content of university environmental education, Lars Emmelin of Trondheim University, points out the following three main dimensions essential for each problem:

> the ecological dimension, which requires a definition and description of relations between man and nature; defining, describing and analysing natural systems which are the object of study, their components and processes unfolding therein (this dimension according to L. Emmelin, is often viewed in physical, rather than ecological, terms);
>
> the socio-economic dimension, including the level of development, the technological set up, the use of resources in the economy, the legal and administrative framework within which measures are taken;
>
> the systems of values, or the socio-cultural dimension of society, i.e. the values and attitudes which govern or rationalize the way natural resources are used and the relations between man and nature. (Ibid., p. 58-59).

The basic concepts of general environmental education, formulated by D. Meadows, the approaches and criteria advanced by D. Kuenen and L. Emmelin, summarize many theoretical and practical suggestions regarding the environmental content of general education, and of higher education, in particular. Along with the above-mentioned criteria, they can be considered as a multiform and multi-dimensional system of scientific criteria and support references for defining this content and for drawing up appropriate syllabuses, courses and textbooks.

Naturally, the system is already open for additions and improvements and will be even more so as research progresses and further practical experience is accumulated.

How does it relate to what was identified as the system of educational criteria? In the first place, no hard and fast line should be drawn between them. A simple comparison shows that

certain elements in both systems are virtually identical (the imperative of the interdisciplinary approach; the consideration of global, regional, national and local phenomena and processes; and the treatment of the different aspects of the environment - natural, social, etc. - as interrelated and interacting parts of a single whole). The other elements of both systems complement each other, and it can be said that, as a whole, both systems are complementary and interpenetrative.

This complementarity could be described in the following way: whilst educational criteria are concerned with pedagogically relevant and goal-oriented elements that should make up the content of general environmental education [in other words, selection of such materials and elaboration of such a system of methods and types of activity that can contribute to the development of an adequate vision of the world and promoting environmental ethics, behaviour and competences - see Section 3.3], scientific criteria aim at selecting specific environmental information based on concrete findings of natural and social sciences, and widely shared scientific concepts, describing the most important environmental processes, the causes of their alteration and ensuing consequences. Taken together, both sets of criteria represent a sort of matrix of reference points for guidance in the determination of the environmental content of general education, and in higher education, in particular.

3.5 Ways and means of integrating environmental content in general higher education

Higher education is traditionally based on previous education and is, in a sense, its continuation. Where more or less traditional general disciplines are concerned, the content of syllabi in higher educational institutions does not, in general, repeat material taught at secondary school. Thus, university mathematics curricula do not provide for the teaching of the four rules of arithmetic, simple algebraic equations or simple interest, etc. When university courses include themes which seem to repeat what has been covered at secondary school, their treatment is different, going further and deeper, reaching new levels.

In considering ways of solving this problem linked to the integration of environmental content in general higher education, it is virtually impossible to find a universally applicable

method. The specific situation in each particular country should be taken into account. If environmental education is firmly rooted in secondary school, if it has been administered for a considerable period of time, if it has more or less stable syllabi and textbooks, if the environmental knowledge received in secondary school is formally assessed in the school-leaving certificate, general environmental education in higher educational institutions can proceed along the lines of deepening and expanding the topics covered in secondary school and developing new ones.

If, on the other hand, environmental content has not become an integral part of the content of secondary education, or is going through the initial stage of experimentation, it is bound to begin at the higher educational level with the most general and fundamental notions which, of course, are then developed at the level and in the depth compatible with the general knowledge and progress of the students.

This is how we view the general approach. But it should be pointed out that there is no single solution. It depends on the particular situation.

Since environmental education as part of general education is fairly new, and its content, ways and methods in the overwhelming majority of countries, if not everywhere, are going through the formative stage, the second option is likely to prevail, and one can hardly count on the environmental knowledge of first-year university students being comparable in scope and systematic character with their knowledge of traditional disciplines.

In this connection, the main document of the above-mentioned Budapest UNESCO-IAU seminar notes that one of the problems of general environmental education for students of higher educational institutions consists in the fact that the subject has no established status in the secondary education system. Environmental problems can be taught as part of geography, biology or chemistry, or can be totally missing in the curriculum. The university lecturer, points out Prof. D. Kuenen, author of the document, has therefore to proceed from the assumption that knowledge of the subject is, in fact, not there, and that he has to start from scratch. (See: Universities and Environmental Education. UNESCO-IAU. Paris, 1986, p.16).

But, on the other hand, thanks to ecological movements, one can expect fairly developed and emotionally backed interest in environmental issues on the part of many young people.

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Integration into monodisciplinary courses or an integrated interdisciplinary course? Already the Tbilisi Conference showed the diversity of the ways, forms and methods of integrating environmental content into the curricula of higher educational institutions. Special classes, seminars, training courses on topics connected with the environment were mentioned. It was noted that, in some cases, specialized departments for environmental education were established and curricula developed.

There are different approaches to the methods of integrating environmental content into general higher education. As for general preuniversity secondary education, the prevailing opinion is that environmental issues should be integrated within the content of respective disciplines. For general secondary schools, such an approach seems indeed, preferable, since, on the one hand, in very many countries the disciplines taught in secondary school encompass the foundations of natural and social sciences and liberal arts, and, on the other, being an integral part of the fundamentals of sciences taught in school, various aspects of environmental knowledge take on a more convincing air, emerge more naturally and tangibly when present as an inalienable dimension of scientific knowledge, ethics and aesthetic norms.

It should be noted, however, that to be fully effective school disciplines should not be treated as separate entities; their content, as well as the curricula and textbooks should reflect the interaction between the phenomena treated in these disciplines. In other words, the world of nature, man and society should be reflected as a whole series of multifaceted interrelations, and not as separate fragmented parts, snatches of reality as can happen with poorly related school subjects. It can also be said that ecologically satisfactory content of general education means a transition from an analytical vision of the world broken up into parts and aspects, often without

any cementing principle, to a synthetic or, more accurately, analytical-synthetic concept of the content of education and curricula.

Such an approach calls for a change, not only in the conce
certain extent, in scientific research itself. Scientific progress in the
embarked upon a restructuring of scientific thinking, making headw
at the junction of different sciences. The integration of environm
education stimulates a similar restructuring of the teaching proc
respect. It has, therefore, a vast potential for the renewal of co
education at all levels. The task is to be able to use this potential.

Fulfilling this task will call for a concerted effort of speci
knowledge and educators, and work in this domain has already be
years, a major role being played by UNESCO and the U
Environmental Education Programme. At national levels, however,
not systematic enough, inadequate efforts and resources being put i

In this connection, it would be useful to set up national
mechanisms to elaborate a renewed concept of the content of gene
the environmental dimension, and also to draw up respectiv
recommended to educational authorities and educational institutio
such mechanisms could be set up at the level of regional auth
education.

In individual educational institutions, interdisciplinary commi
ensuring coherence in teaching environmental topics. Moreover
helpful in showing, through the teaching-learning process these phe
transcend the boundaries of one, separate discipline.

The general considerations and approaches offered above
modalities of integrating an environmental dimension into the

education. At the same time, in view of certain particularities of higher education, two of which are mentioned below, these considerations and approaches should be supplemented and specified.

First of all, higher education, including general university education, is already specialized even at the level of such broad categories as natural sciences and social and human sciences. If we restrict ourselves to the integration in the disciplines taught in one or the other of elements and aspects of environmental issues corresponding to them then a considerable proportion of other [illegible] aspects remains outside the scope of [illegible] education. [illegible] all departments on the main problems of relations between man and the environment, not only in the field of natural and exact sciences, but also in the field of social sciences and the arts. (Final Report of the Tbilisi Conference, Recommendation No. 13). Many specialists support the idea of such a separate general course.

One could also think of supplementing the integration of environmental issues into the disciplines taught in one or other field of specialization with a parallel interdisciplinary course developed on the basis of the major branches of scientific knowledge, not represented as such in the curriculum of the given field of specialization. In other words, it could mean that a course for social sciences and arts students would handle environmental issues from the point of view of natural sciences and demonstrate their links with socio-economic, political and legal aspects, whilst a course for natural sciences students would embrace socio-economic, political and legal aspects and their links with the natural sciences.

However, this option may prove to be artificial and its acceptance would imply that a satisfactory level of integration of an environmental dimension in the major disciplines of a field of specialization had been achieved. It could be used in situations where one could be positive of such an achievement. On the whole, however, the first option, based on a broader interdisciplinary approach, could at this stage prove preferable and less problematic.

It stands to reason that general environmental courses do not preclude an in-depth treatment of topics which more immediately relate to the professional interests of the students (thus, for example, a doctor will find it very useful to have knowledge of landscape geochemistry, since the chemical composition of local soils, surface water and vegetation can affect health). However, by and large, the mastering of practical aspects of ecology, essential for the future professional activities of the students, calls for different approaches to the teaching of ecological knowledge.

A great variety of environmental data related to [illegible] and other branches of environmental knowledge is needed by the specialists in agriculture, such as farmers, engineers and lawyers. While, for instance, a soil scientist will deal with soil plants and animals, fertilizers and weed-killers, for an architect it will deal with urban environment, typically harmful factors (noise, air pollution, etc.), town planning, etc. In such cases it is possible to introduce both special courses in ecology (such as "urban ecology", "agricultural ecology", etc., or "environmental law") and the "ecologization" of traditional professional courses, i.e. the introduction into these courses of environmental topics and, more importantly, environmental approaches, points of view, and angles from which special professional problems are viewed.

The curricula for this second sphere of environmental knowledge should be developed jointly by ecologists and specialists in the fields of knowledge in which students major, so that the syllabi would be sound both from the point of view of ecology per se and from the point of view of the future professional requirements of university graduates.

Of special concern is the environmental education of school teachers, especially biology and geography teachers.

The level of public awareness of environmental matters depends, not only and not so much on the very narrow circle of environmental specialists and even on the environmental knowledge of a broader circle of specialists, but rather on the education received by children, particularly in school. And if this is so, it is impossible to overestimate the importance of environmental education of prospective teachers. Curricula for future teachers should contain both general and

special ecological subjects, and in a number of cases, thorough practical training should be provided; thus, future school geography teachers must be given an opportunity to participate in training and scientific expeditions, whilst future teachers of biology and chemistry will undertake substantial experimentation in these domains, etc.

Another peculiarity of higher education consists, finally, in a certain uniqueness of every, or nearly every, educational institution, and secondly, in the autonomy, not infrequently the very high degree of autonomy, of higher educational institutions as compared with other units of [illegible] organization and teaching, etc. This inevitably creates a multiplicity of organizational solutions, not necessarily providing a priori practical for finding the best option.

Co-operation, information. But in any case, for the maximum number of students to be involved in one or other form of environmental education, it is important to dispose of, both a clear and detailed system of educational and scientific criteria to determine its content, and an implementation strategy co-ordinated within the higher educational institution, faculties and departments. This calls for joint research and methodological work by professors and lecturers in different fields which could be organized and co-ordinated by permanent working groups attached to scientific councils of higher educational institutions.

Progress in integrating environmental education within general education can be considerably expedited by well organized co-ordination, consultation and information at the national level. The availability of a flexible mechanism maintaining constant links between higher educational institutions, bodies dealing with environmental protection and specialized research centres may prove useful in organizing this activity. Such a mechanism could contribute to promoting co-operation with similar mechanisms in other countries, and with international organizations.

At this point, brief mention should be made of an important function best served by universities or other higher education institutes.

University and lifelong environmental education. Besides basic university environmental education of non-ecologists, special environment refresher courses should be organized for specialists having terminated the formal education some years ago, and also for those not having received environment instruction. Universities are probably the best place for "retraining", although other possibilities could be considered.

This aspect is extremely important in terms of preserving and improving the environment, particularly at local levels. Indisputably, many environmental errors in siting industrial enterprises have been committed by environmentally ignorant planners. Thus, in the former Soviet Union, many especially harmful facilities, such as chemical, petrochemical, pulp and paper plants, iron and steel works, etc., were sited in big cities, sometimes even in the immediate vicinity of densely populated areas; in many instances, as was discovered later, large numbers of inhabitants need to be resettled elsewhere and sanitary zones set up. This would be totally unnecessary had there been environmentally-sound and informed planning. Obviously, this is not due to any ill intent on the part of planners, but to their environmental ignorance.

The rapid progress of ecological science calls for constant renewal of environmental knowledge of those whose activity affects the environment. For various reasons, some of them are incapable of doing it effectively on their own, even if they had some environmental instruction in their student years. Universities could undertake constant refresher work to retrain non-ecologists in environmental issues.

3.6 Evaluating implementation of selection criteria for the environmental content to be integrated into general higher education: some aspects

Effective education and, specifically, implementation of criteria for selection of the environmental content of general higher education, implies a sound evaluation of parameters of the educational process. Broadly speaking such an evaluation will mean evaluation of general environmental education as a whole because, as mentioned earlier, integration of the environmental dimension into general education, in effect, means integrating environmental

content into that of general education. Therefore, the degree of implementation of criteria for the selection of environmental content to be integrated into general education content is tantamount, to a great extent, to an evaluation of the degree of success of general environmental education, and vice versa.

An evaluation of some aspects of education can be made from different angles, concentrate on various aspects, components and phases of educational systems or educational process or it can take place at different levels (macrolevel, microlevel, individual level) and refer to all, or to specific participants in the process. Evaluation can be internal or external, i.e. evaluation of some activities carried out in an educational institution by an outside expert or body, is external, whilst internal evaluation is undertaken by an institution's own specialists.

The systematic discussion of all relevant aspects of evaluation, its various parameters and different angles would require a whole new study. Applied to the subject of this study, it can be limited to a discussion of the scope, or different levels of evaluation, allowing concentration on the evaluation of various components, aspects and factors of the educational process pertaining to general environmental content in higher education, and to implementation of criteria for its selection.

For education, the highest level of evaluation within a country is the national level. There can also be evaluation at higher levels, i.e. a commonwealth or an association of States, at the regional or international levels, by a special ad hoc body or by existing co-ordination and co-operation structures.

At the national level, evaluation of the degree to which efforts to integrate environmental content into general higher education, and of the content itself, correspond to the criteria for its selection or, in other words, to objectives and principles of general environmental education, will involve a wide range of issues. These will, to a great extent, coincide with the aspects to be covered by evaluation of general environmental education as such, irrespective of the level,

although certain differences will be evident due to specific features inherent in higher education (see Section 3.5).

First, it will probably be necessary to find out whether there are, at the national, state, province or canton levels (if education is under their auspices), any laws, decrees, plans, recommendations or other official texts formulating environmental education policy. It will be of special interest if such documents also contain recommendations as to the subject-matter of courses in environmental education or specific indications for universities and/or other higher educational institutions.

It would also be interesting to ascertain whether there exist, at whatever levels, any recommended syllabi or teaching materials for environmental education and, in the affirmative, whether they refer to any criteria for selection of content and ways to integrate the environmental dimension into general higher education curricula. Any such syllabi, courses and curricula, or other relevant documents, should be thoroughly analysed.

Evaluation at this level - the macrolevel - should enable the evaluator to become acquainted with the functions, content and working methods of the body, structure or mechanism directly responsible for co-ordination and information exchange between institutions of higher learning and their staff on the content of environmental education, selection of teaching material, and methods for integration into courses and curricula. This body or structure can be governmental or non-governmental, national or local, operating at a state, canton or province level, or in a city with two or more higher education establishments.

The next level of evaluation is at the level of a university, or a similar higher education institution. At this level, it is also important to obtain any existing documents formulating a general environmental education policy or plan for the institution as a whole, or for its faculties and departments, to ascertain whether these documents contain any guidelines as to material selection criteria, ways of integrating environmental content into traditional disciplines or into the content of a special interdisciplinary course on environmental problems.

At this level, special attention should be paid to different forms of teacher and student participation in protection, conservation and improvement of the environment. Participation in such activities is especially important for the development of environmental ethics, appropriate skills and, to a certain extent, environmentally sound behaviour and meets one of the main criteria for the determination of general environmental education content, namely, selection of teaching material and practical work promoting the formation of those qualities constituting the ultimate goal of environmental education.

Various forms of this type of activity are offered by higher educational institutions although they are not always incorporated as such into their curricula and courses. However, some institutions of higher education plan extension work, closely linked to the content of theoretical courses and research. One such example is the Federal University of Para, Brazil, where students participate in interrelated classroom instruction, research and practical extension work. The latter includes field work in co-operation with local farmers. As shown in the report of the Association of Amazonian Universities on the pilot project for incorporation of Environmental Education in the Curricula of the UNAMAZ Members, this kind of activities provide an opportunity for students "to review their professional posture and their acquired knowledge in real-life conditions with resulting behavioural changes" (see: Association of Amazonian Universities. Environmental Education in the Pan Amazon. First Phase Report ... Contract UNESCO/UNA/MAZ. Belém, Pará, Brazil. 1991. p. 24, 28, tables 5, 8, 9).

Most useful for the evaluation of university education would be any documents concerned with general environmental education content, and the principles, approaches and criteria for its selection. Evaluation will also involve activities of individuals or services and departments at the institution whose task is to co-ordinate efforts in environmental education within the institutions, organize interdepartmental exchange of information and teaching experience and co-operate with other higher education institutions in their country and abroad.

As for evaluation at the national level, it is of prime importance that conclusions drawn from the analysis of collected data should contain practical recommendations, both on the positive

aspects that, in the evaluators' opinion should be encouraged, retained and developed, and on those where there are gaps to be filled, priorities to be changed or efforts intensified.

To choose the best procedure for evaluation and to render it effective and reliable, evaluators should, in both cases consult their evaluees to discuss preliminary conclusions and possible recommendations, before these are finalized in a report. This will make evaluation a democratic and constructive process fostering a better understanding between evaluators and evaluees, and will create favourable conditions to comply with recommendations.

It should be borne in mind that, in some countries, evaluation at the level of a university coincides with the national level, or the level of a state or province because the university might be the only higher educational institution in existence. In such cases, evaluation at the university level would be macrolevel evaluation. On the other hand, the fact that institutions of higher education, especially universities, are usually vast, ramified structures involved in large-scale teaching-learning and research activities, it would be reasonable to equate university level evaluation with macrolevel evaluation, even in a country with many universities or other higher educational institutions.

Another level of evaluation, the microlevel, could be the assessment of a single course, either in a traditional discipline like biology, chemistry, geography, demography, etc., or a special interdisciplinary course on environmental protection. In the former case, it would be necessary to determine the degree to which the potential of a given discipline is used for general environmental education, to what extent its environmental content meets the pre-formulated criteria of its selection, and whether different courses complement one another in their environmental content, and if so, how this is reflected in the teaching material. A challenging task here will be to assess the degree of integration of environmental content into the syllabi of a given discipline and whether it has become an essential dimension of the latter.

The degree to which content of a course corresponds to the pre-formulated criteria is important when evaluating a special interdisciplinary course. But, the inclusion of such a course

into the curriculum does not rule out the need to integrate an environmental dimension into traditional courses. It would be useful to find out which courses - traditional or special - show more consistency in adherence to the adopted material selection criteria and in determining the general environmental education content.

The degree of academic autonomy of higher educational institutions, varies from country to country, some formulating their own criteria for general environmental education content and working out different methods of integrating it into the syllabi of general disciplines. Such diversity will most certainly produce a wealth of interesting ideas, and is to be encouraged. Evaluation of different methods and criteria, although complicated by their plurality, will enable evaluators to compare the efficiency of the approaches and will be of both practical and theoretical interest, for all involved in environmental education.

Perhaps the decisive level of evaluation of the effectiveness of environmental education and the degree to which criteria determining its content are successful, i.e. achievement of goals, objectives and principles, is the level of an individual university or college student.

Indeed, it is the ethical attitudes, behaviour and habits of an individual that provide a reliable criterion of assessment of the success of general environmental education, relevance of its content, and adequacy of its organization, the teaching-learning process and methods of developing appropriate environmental awareness and attitudes.

Of all the levels and types of evaluation, that at the individual level is backed by the longest history and tradition; it is also the most delicate and complicated, its object being a person who is unique in his or her perception of the world, outlook and methods of assimilating information.

Usually, traditional evaluation is concerned with knowledge, competence and skills. It has been discussed in numerous publications and there is probably no need, in this study, to try to formulate any new approaches. It should be pointed out, however, that to evaluate implementation of criteria to determine environmental content as a major dimension of general education, and the extent to which general environmental education in its broader sense is successful, evaluators

should not limit themselves to an assessment of the knowledge, competence and skills acquired by a student but, in this particular case, go further to attempt to discover to what extent the implementation of these criteria, and the educational process as a whole, are conducive to students' assimilation of environmental ethics and behaviour. This is clearly a complex and delicate task, difficult to accomplish through traditional methods. One possibility could be to assign students tasks providing them with an opportunity to show how they would act, placing them in an environmentally complex situation, involving them in a public discussion of a global or local problem, or in field work, or giving practical assignments on environmental protection, conservation and improvement.

However, true evaluation of acquired environmental ethics, knowledge and skills can be made on the basis of professional behaviour and daily activities of a university graduate. Methods of evaluating this final result of general environmental education are yet to be elaborated, whilst the evaluation itself becomes a sociological, rather than an educational task.

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The above analysis and commentary are intended to give a general idea of possible levels and aspects of evaluation of implementation of criteria to determine the environmental content to be integrated into general higher education.

Evaluation is an essential part of the teaching-learning process, as well as of other aspects of education. It is indispensable for the assessment not only of the performance of the two main actors in the educational process, the teacher and the student, but also what is being done "behind the scenes" to help to make it happen, and, finally, to establish how successful it has been.

For a branch of education as new as environmental education, systematic evaluation is all the more important in that it helps to improve its content, criteria for selection, methods of integration into general education, as well as its ethical impact on students.

Chapter 4

SOME COMPONENTS OF ENVIRONMENTAL CONTENT OF GENERAL HIGHER EDUCATION AND THE CRITERIA FOR THEIR SELECTION

The present study does not aim to offer a systematic presentation of environmental content elaborated on the basis of the above criteria, for its integration into general higher education. However, to translate it into more concrete terms it seems useful to look at several fairly well studied global and regional environmental problems, whose selection for inclusion into curricula and courses of traditional or specially designed general environmental disciplines is prompted by a number of scientific and educational criteria.

In accordance with these criteria, in each particular case briefly outlined below, we deal with scientifically reliable facts showing a dangerous breach of or deviations from conditions necessary for the normal existence and reproduction of organisms, for the health and life of man, and for the social and economic progress of society. In each case we refer to the complex multifaceted nature of the selected phenomenon governed by physical, chemical and biological laws, as well as by the consequences of man's activity. Each problems is connected with the complex basic concept of 'environmentally sustainable' development, in the sense that man, society or certain groups, in a bid to reach certain goals which are expected to improve their situation, commit actions destructive to natural (biochemical) cycles and potentially incompatible with the reproduction by the environment of conditions favourable for the life of organisms and man himself (see above: 3.4 - Scientific criteria; Accuracy of knowledge; and Adequate reflection of basic concepts). Moreover, some of the problems are openly accompanied by the mutilation of the environment, the violation of natural and man-made harmony and balance (see above: 3.3 - The goals, objectives and principles ...; The criterion of environmental ethics).

In accordance with other criteria, familiarization with these problems makes it possible to acquire the kind of knowledge whose character and direction are described above (see: 3.3 - The goals, objectives and principles ...; Objectives as criteria).

Such knowledge, in line with the considered criteria, will be inevitably of an interdisciplinary nature.

Furthermore, it contributes to understanding the need to co-operate and co-ordinate actions internationally and regionally for the solution and prevention of many environmental problems.

One could go on referring to other criteria which underlie the knowledge essential for understanding the causes and consequences of problems described below. But we could probably draw a line here.

It should be added that the use of modern audio-visual aids, in particular videos, films, etc., in lending visual clarity to knowledge and facts on selected global and regional problems, can appeal to students' emotions, and making scientific knowledge more solid will help to share certain ethical attitudes and convictions (see above: 3.3 - The goals, objectives and principles ...; Criterion of environmental ethics).

Among the criteria to determine the general environmental content of curricula, there is that of promoting the shaping of ecologically sound behaviour of individuals and of developing skills to effectively participate in the preservation of the environment and in the solution of environmental problems. It may seem that it is hardly applicable in the case of global and regional environmental problems and that it should be taken into consideration in selecting the material pertaining the local and national problems. But this is not quite so.

Indeed, among the reasons generating and sustaining global and regional problems there is the cause, though not the most important one, of environmentally ignorant or irresponsible individual behaviour of millions of people, on the one hand - their estrangement from and non-involvement in the solution of fairly simple problems which can be solved individually and which, taken together, are significant for the state of the environmental on a global scale. Higher educational institutions and academics should include in corresponding courses or in the general programme of their work functions and activities which will encourage the moulding of environmentally reasonable behaviour. The tasks also consist in involving students in solving those problems of the immediate environment which, though not threatening it directly, generate global and regional problems when the actions of millions of people on the planet are regarded in their totality.

Taking into account all preceding considerations, a number of problems are presented below.

At the same time, it should be stressed that economic development and technological progress are not inevitably attended by the emergence and exacerbation of environmental problems.

Given that certain conditions are observed and requisite investments are made, technological progress and sustainable economic development can be ensured without the deterioration of the environment and even with its improvement. In most general terms we can say that it requires a thoroughly devised and consistently implemented ecologically sound economic, technological and social policy. Among other things, it presupposes slowing down and halting the growth and then reducing the use of fuels discharging carbon dioxide in

combustion (coal, oil, gas, wood, peat, etc.) and the introduction of energy - saving technologies: greater utilization of solar energy, the energy of the wind, tidal and geothermal waters, the potential of biotechnology, etc.; the protection of the flora and fauna, an end to forest clearing or its compensation in the form of planned and ecologically substantiated planting of trees; a thrifty attitude to water and especially fresh water resources, scientific evaluation of possible environmental consequences resulting from the construction and operation of different facilities on rivers in industry, agriculture and for other purposes before the corresponding decisions are made; a system of measures to prevent the pollution of the atmosphere, soils, rivers and seas, of different water reservoirs; taking into consideration, along with economic and social goals, environmental criteria in drafting decisions on siting various facilities and new residential areas; consistent measures to overcome mass poverty; a thoroughly thought-out demographic policy; a sustained nation-wide environmental education effort and the promotion of environmental education at all levels and in all forms of education.

Such global environmental policy involves, besides will and determination on the part of the State, considerable outlays, which may prove unaffordable for many countries, and, in the first place, for most of the developing countries. The world community and first and foremost the industrialized countries, must help them. This accords with their interests and is dictated by the duty of global solidarity.

This study concludes with several brief references to successful efforts in solving and preventing environmental problems and in restoring the quality of the environment.

Familiarizing students with this kind of experience is of indisputable interest irrespective of their specialization. Therefore there is enough reason to include it in the content of general higher education.

4.1 Global problems

4.1.1 Global environment and population growth

Familiarization with the processes discussed below allows acquisition of the type of knowledge the selection of which, with a view to provide general environmental education within the system of higher education, meets the criteria introduced respectively in Section 3.3 ("Objectives as criteria") and Section 3.4 ("Adequate reflection of basic concepts").

It is generally recognized that the current exacerbating global environmental crisis stems from the rapidly growing anthropogenic pressure on the planet's biosphere. In this connection it is extremely important to determine the possible and most likely changes in the size of the earth's population in the future on the one hand, and the probable dynamics of the amount of "environmental pollutants" produced by an average person, on the other.

The twentieth century, and especially its latter half, has seen an unparalleled expansion of the planet's population While in 1900 according to demographers the earth's population was 1,656 m. people, in mid-1987, the 5,000 millionth inhabitant was born, that is, the planet's population has trebled over a period of 87 years. In the past 40 years, the earth's population has more than doubled (2,500 million in 1950 and 5,200 million in 1990) the population of industrialized countries going up by less than a half (45%), while the population of developing countries - 2.4 times (140%), that is, the population of developing countries was growing twice as fast as that of developed countries. While in 1950, two-thirds of the earth's population lived in developing countries, in 1990 this figure stood at three-fourths (67% and 77% respectively).

Many ecologists believe that continued rapid growth of the planet's population will inevitably precipitate an ecological catastrophe, of which they insistently warn both governments and the public. A swift deceleration of this growth, and better still its discontinuation would dramatically raise the likelihood of saving the earth's biosphere and of preventing an environmental crisis. Extremists claim that a considerable reduction of the earth's population is necessary and hold that this can be brought about fairly easily.

What is the nature of the "demographic explosion" (as rapid population growth is figuratively referred to in the popular press) and what are the most likely trends of population growth in the foreseeable future?

The demographic explosion results from a much lower mortality rate accompanied by continued high birth rates, which means that the drop in the birth rate lags considerably behind the decrease in the mortality rate. This is the first stage of the so-called demographic transition, or demographic revolution, which essentially amounts to a transition to fundamentally new mode of population replacement (based on low birth and mortality rates). Formerly very high mortality rates meant the survival of only those peoples who had high birth rates and who had at least simple replacement, that is, a situation where the number of children born is sufficient to replace quantitatively the parent generations.

Changed socio-economic conditions of life, improved well-being, advances in medicine have all brought about a lower mortality rate, while demographic orientation aiming at a big number of children or even a resigned attitude to birth (let there be as many children as God wills, and in most cases he willed many children) remains the same or almost the same for some time, it is changing at a much slower pace than the mortality rate. Demographic orientation is changing at a particularly slow pace in developing countries, due for the most part to traditional lifestyles.

Demographic history attests to the fact that a more or less rapid acceleration of population growth has been registered with all nations and all countries of the world including

those who have shown a sharp decrease in replacement, i.e. where the number of children born is well below that required for the quantitative substitution of parent generations. However, nations that entered the stage of demographic transition earlier (the nations of Western Europe) had a much less dramatic demographic explosion than that of the developing nations today, where the demographic explosion coincided with impressive achievements in medicine, connected with the discovery of antibiotics and wide use of other highly effective medicines, which resulted in a much greater average life expectancy, thus decreasing premature mortality, especially in infants. While in 1955 average life expectancy was 49.9 years, in 1980-1985 it reached 64.6 years, the biggest increase (from 41.2 to 57.9) being registered in Asia, the part of the world with the biggest population. Infant mortality rate (i.e. the number of newly-born babies who died before the age of one per each thousand) has gone down over the same period from 147 to 81 (see: Our Common Future, p. 103, Table 4.3). As we see, the progress of the world community in the demographic sphere, despite setbacks in the environmental situation, has been great, but it was this same progress that, by accelerating population growth, brought about a further deterioration of the environmental situation.

Since population growth is especially intense in the poorest countries, we witness a quicker pace of transformation of natural landscapes into farmland, the destruction of natural bio-coenoces of forests and steppes; territories with natural vegetation are turned into plough-land and pastures, usually of low fertility (in particular, because more fertile soils have been cultivated earlier). Thus, large areas of tropical rain forests - the main producers of oxygen and absorbers of atmospheric carbonic acid on the planet - constantly turn into low-fertility farmland.

This is how the vicious circle originated: low living standards bring forth a high birth rate, the rapid population growth impairs higher living standards, poverty entails inefficient extensive agriculture, i.e. more and more natural landscapes have to be involved.

The potential growth of the earth's population is especially important in terms of the environmental future of the earth.

According to UN forecast the population of the earth will exceed 6,000 million by the year 2000, while in 2025 it will be over 8,000 million.

Demographic forecasts are far from being translated into reality in all cases. In particular, the world's population has recently been growing at a considerably slower pace than predicted several decades ago. The rate of the population growth is decreasing everywhere except Africa. In the world as a whole it was highest in the second half of the '60s - about 2.1% on average annually; in the second half of the '80s the average annual growth was already 1.6%. A slowing down of the growth of the African population is expected in the first half of the 90s.

Many industrialized countries already have a restricted replacement of the population; i.e. fewer children are born than is necessary for the quantitative substitution of the parent generation. In many European countries (Germany, Austria, Denmark, Sweden) a natural decrease of the population is in evidence. In other developed countries the natural increase of the population is brought about by the fact that the babies born **quantitatively** replace not the parents but the grandparents and great-grandparents (the average age of mothers at the time of childbirth is about 25-27; of grandmothers - 50-55, of great grandmothers - 75-80); the share of those generations is lower than it would be had the entire demographic pyramid (age structure) been formed at the current pattern of population replacement. In point of fact, the demographic situation here is unsatisfactory and requires special measures to keep up the birth rate. The demographic development of the entire world is proceeding along the same lines. Not only the relative, but also the absolute, growth rate of the world's population is bound to decline. Most experts who looked into this question believe that the growth of the world's population will stop at around 10,000 million, i.e. the population of the world will roughly double. Gradually the world's population will approach the so-called **stationary** mode, i.e. it will be stable in terms of its numerical, age and sex composition.

Even if this most probable variant of the earth's demographic future is the case, the anthropogenic pressure on the planet's biosphere will rise dramatically. If we assume that the amount of environmental pollutants per average person does not increase (which is obviously unrealistic), the pressure will double.

Environmentalists' concern over rapid population growth is well-grounded. However, real possibilities to slow down the pace of population growth with the help of a purposeful demographic policy are not so great as is usually believed by those who are far from demographic science. The pace of population growth changes more or less automatically along with the socio-economic progress of the respective countries. It is a well-established fact that women employed in the national economy outside their own home have much fewer children than those who work only in the family; that women with a higher educational standard have fewer children than those with a lower standard; that material standards and the birth rate are in inverse proportion: the higher the standard, the fewer the children; the birth rate decreases in late marriages, etc. To reduce demographic growth and consequently the anthropogenical pressure on the earth's biosphere, to prevent a global environmental catastrophe it is necessary, above all, to stimulate the socio-economic development of the Third World - the developing countries. The industrial and post-industrial "North" must help the agrarian "South" to modernize its economy in ways acceptable to it. It is pointless to offer and advertise birth control methods if people mean to have many children, if the realities of their everyday life constantly call for and encourage such demographic imperatives.

The most potent factor in reducing the birth rate and the natural growth of the population is urbanization, i.e. raising the proportion of city-dwellers, the development and

spreading of the urban way of life. Replacement coefficients, per se, of city-dwellers are much lower than those of rural inhabitants of the same countries, given that other conditions (nationality, educational standards, etc.) are the same. Not infrequently we observe restricted replacement among city-dwellers, while rural inhabitants demonstrate sharply extended replacement.

It goes without saying that urbanization brings in its wake many other environmental hazards, particularly in connection with the concentration of vast masses of people in mammoth multi-million cities and agglomerations.

The dynamics of the population growth can be considerably influenced by a changed environmental situation, its deterioration, which may be one of the consequences, often unexpected, of certain breakthroughs in medicine. Thus, in the opinion of some ecologists, the AIDS epidemic was provoked by success in combating virus diseases of man. N.F. Reymers holds that "the environmental nature of AIDS" has become quite obvious. It was predicted in the 60s proceeding from fairly simple ecological laws and rules, thus, there is a rule saying that an ecological niche is bound to be filled. True enough, medicine has helped us to conquer many diseases through destroying their agents. A vacant ecological niche appeared. It had to be filled. By what, or, more accurately, by whom? According to the elementary rule of ecology, by an evolutionary simpler organism, smaller in size and much more mutable - genetically changeable. In those years the best-known Janus with many faces was the flu. The prognosis said: "A high-lethality flu-type disease".

The changeability of HIV (human immunodeficiency virus) is of a higher order than that of the flu virus. So far it is transmitted sexually and through blood. How long will it remain so? No one can tell. And what if it begins to be transmitted from person to person through air, like the "flu"? (See: N. Reymers, "On Ecology and Not on It Alone") in: "USSR: a Demographic Forecast", Moscow, 1990, pp. 107-108).

Some competent biologists believe that AIDS is the first portent, a "scout" of wars that will be followed by a whole series of AIDS-type diseases.

Some countries tried to control the natural population growth administratively. Abortions were banned in some countries (USSR in the 30s, Romania in the 70s ...), while in others a limit was set on the number of children in the family (China in the 80s). Meanwhile, the general rule here should, perhaps, be this: the State and society create conditions where people want and can have as many children as would best suit the interests of the community, including the environmental interests, which means that family planning should be administered only indirectly and humanely.

As far as the role played by the pace of the population growth among the factors aggravating the ecological crisis is concerned, opinions differ greatly. Some believe that it is

the major factor, while others think that it is of little significance. The main argument of the latter is that the environmental situation in many densely population countries (such as the Netherlands) is incomparably better than in others with similar natural conditions where the population density is much lower.

4.1.2 The growth of cities

The twentieth century has witnessed an urbanistic revolution, a rapid growth of cities, the concentration of people in the biggest cities, urban agglomerations and conurbations. Now the world is half-way through this revolution.

In 1940, every eighth person on the planet lived in cities, and only one out of 100 lived in a city with a population over a million.

In 1980 every third inhabitant of the earth lived in a city, and every tenth - in a city with a population over one million.

It is expected that in the year 2000 half of the world's population will live in cities, and the share of cities with a population over one million will rise dramatically.

According to forecasts, the population of the world's biggest cities will number of over 20 million each (Tokyo, Mexico City, etc.).

The growth of the urban population in the Third World countries has been especially rapid and will remain so. Here are some instances of this unprecedented growth.

City	Population, mln. people		
	1950 or the year closest to it	1980 or the year closest to it	2000 UN forecast
Mexico City	3.0	16.0	26.3
San Paulo	2.7	12.6	24.0
Bombay	3.0	8.2	16.0
Jakarta	1.4	6.2	12.8
Cairo	2.5	8.5	13.2
Delhi	1.4	5.8	13.3
Manila	1.8	5.5	11.1

During the 30 years between the 1959 and 1989 censuses, the number of big cities in the former Soviet Union with a population over a hundred thousand each, exactly doubled from 148 to 296. Among experts on cities, the USSR has long been regarded " a country of bit cities" for having an extremely high share of such cities.

Over the same 30 years the number of cities with a population of over a million in the Soviet Union has gone up from 3 to 23.

Most importantly, around most big cities there emerge agglomerations - clusters of interdependent cities, towns and townships. Moscow, the capital of Russia, has a population of 9 mln., while that of the Moscow agglomeration is over 15 mln.

Many major cities in industrialized countries unlike those of the former USSR and the developing world are losing their population, but the number of people living in agglomerations, of which they are part, is growing, i.e. the concentration of people on certain small territories is becoming more dense.

As a rule, major cities and agglomerations have developed industry, producing much waste and polluting the air, surface and near-surface waters and soils. Particularly serious and fast-growing pollution of the air of cities and agglomerations is caused by public transport and especially private cars. Additionally, the urban population produces large quantities of solid and liquid household wastes.

All creates acute environmental problems of major cities and agglomerations, even when the cities have sufficient resources to build powerful and effective facilities for the collection and utilization of wastes, when the city infrastructure is well developed, when there are enough means to maintain old buildings and facilities and to build new ones to provide well-appointed housing for the growing number of city-dwellers.

However, outside the small circle of industrialized countries, these favourable conditions are generally lacking.

The result, in the words of the Brundtland Commission Report, is "mushrooming illegal settlements with primitive, increased overcrowding, and rampant disease linked to an unhealthy environment" (Our Common Future, p. 238).

In many cases, the environmental situation in cities can best be described as an ongoing crisis.

"In most Third World cities, the enormous pressure for shelter and services has frayed the urban fabric. Much of the housing used by the poor is decrepit. Civic buildings are frequently in a state of disrepair and advanced decay. So too is the essential infrastructure of the city; public transport is overcrowded and overused, as are roads, buses, and trains,

transport stations, public latrines and washing points. Water supply systems leak, and the resulting low water pressure allows sewage to seep into drinking water. A large proportion of the city's population often has no piped water, storm drainage, or roads" (ibid., p. 239).

In many cases cities lack sewage purification facilities for industrial and household wastes, or, in any case, do not have sufficiently effective facilities so that non-purified or inadequately purified effluents are dumped into natural water wastes. Pollution is often so strong that self-purification capacities of even big rivers are insufficient for the restoration of the relative purity of the water. Thus, for example, as a result of dumping large quantities of nitrogen and phosphorus into the Dniepr, Europe's third-longest river, and in the past few years the Volga, Europe's longest river, they have become overgrown with duckweed. This process is a mass proliferation of blue and green algae which lend the water a green colour. Their dying and subsequent decomposition are accompanied by the consumption of large quantities of oxygen, fish suffocate to death, there is a stench of decay.

This is how things stand in one of the greatest developing countries of the world. "Out of India's 3,119 cities, only 209 had partial and only 8 had full sewage treatment facilities. On the river Ganges, 114 cities, each with 50,000 or more inhabitants dump untreated sewage into the river every day. DDT factories, tanneries, paper and pulp mills, petrochemical and fertilizer complexes, rubber factories, and a host of others use the river to get rid of their wastes" (Our Common Future, p. 240).

The situation in the developing countries is aggravated by the fact that industrialized nations seek to site their polluting production complexes there, in part because environmental legislation here is not so strict, which means lower environmental costs.

Environmentally hazardous cities are characterized by a high incidence of disease, many conditions being directly related to the poor state of the environment. "Acute respiratory diseases, tuberculosis, intestinal parasites and diseases linked to poor sanitation and contaminated drinking water (diarrhea, dysentery, hepatitis, and typhoid) are usually endemic; they are one of the major causes of illness and death especially among children. In parts of many cities, ... one adult in two is suffering from intestinal worms or serious respiratory infections" (Ibid., pp. 239-240).

Here we observe a graphic relationship between the environmental and economic situation. Ecologically sound technologies capable of radically improving the environmental state of the cities and of the roads call for hefty additional expenditures. According to available data the outlays for sewage treatment facilities at some industrial enterprises in Europe reach 40% of their overall cost.

Undoubtedly, the environmental situation in cities depends in large measure on both environmental legislation and the observance of laws. As a general rule, this legislation falls

seriously behind the actual need for it, especially in the developing countries. It is not always sufficiently strict to promote environmental well-being, neither is it always complied with.

The concentration of people on small territories in cities with a population of over a million and in major agglomerations will doubtless continue and intensify. In many cases environmental problems are likely to multiply. What is required to prevent it and to somewhat improve the situation is, among other things (environmentally safe technologies, sufficient investment, etc.) environmentally competent planners, technologists, and on the whole environmentally educated people who could effectively stand for their rights to a healthy environment.

4.1.3 The greenhouse effect

This is one of the most perilous global dangers threatening mankind.

This is what it amounts to:

man's economic activity generates into the atmosphere a growing amount of carbon dioxide (CO_2, carbonic acid), as well as a number of other gases less relevant (in this context);

carbonic acid is easily permeable for short-wave radiation, but much less so for long-wave or infrared radiation: this, in its turn, changes the heat balance of the earth, the earth's surface and atmosphere grow warmer, hat up, a "warming-up of the climate" takes place, on a global scale, of course, very slow and minute, but lending itself to instrumental measurement;

the warming of the air causes changes in the entire system of atmospheric processes (the directions of cyclones and anti-cyclones, their rate of change, the amounts of heat and moisture they carry ...), which is responsible for changes in the **climate** of different areas (and not just the weather): some parts become drier and warmer while others, conversely, become cooler and more humid. This is connected with the changes in the boundaries of natural geographic zones, thus, in some parts of the earth the encroachment of the desert on the steppe, i.e. desertification, takes place; the further "warming of the earth", according to specialists, will inevitably cause the thawing of the mainland glaciers (Greenland and the Antarctics) which will raise the level of the world ocean and flood large parts of lowlands which rise little above sea level; these lowlands are very densely populated, they have long been cultivated, some of them belong to the most developed parts of the world socially and economically (much of the Netherlands is below sea level, it was reclaimed from the sea and protected from floods by dykes); other places on territories slightly above sea level are inhabited by a large and dense population (Bangladesh and other countries).

The "global warming" that occurred in the past few decades has graphically manifested itself on the territory of the European part of the former Soviet Union. On average, winters here have become much warmer, and summers cooler. The level of the Caspian sea - the world's biggest lake - which kept dropping for a long time, is now rapidly rising. The climate of the European part of the former Soviet Union is largely shaped by the Atlantic. It is from the Atlantic that the biggest part of the cyclones come here. Recently these cyclones have been coming more frequently and are moving at a faster and more vigorous pace. Atlantic cyclones bring with them heat and moisture in winter and moisture and coolness in summer. Lower summer temperatures reduce evaporation from the earth's surface - its lands and waters (lakes, swamps, water reservoirs and rivers), therefore the share of run-off is going up. It is exactly this that has brought about the raising of the Caspian Sea level, despite the fact that on its main tributary, the Volga, Europe's longest river, many major water reservoirs were built, and much more water is drawn for agricultural irrigation than was the case previously; evaporation from water reservoirs and the consumption of water for irrigation reduce the flow into the Caspian Sea.

According to some leading experts in global meteorology, there exists a danger of a rapidly accelerating global warming contingent on a possible disappearance of the Arctic Ocean's polar ice cap in the near future. It will only take a slight rise in atmospheric temperature to destroy the ice cap. The ice of this ocean is covered with very white snow. Snow reflects up to 95% of the energy directed at it, while water absorbs a much bigger share of the energy directed at it than snow-covered ice. The emergence on the earth of vast additional open spaces of water will bring about a sharp temperature rise and will upset the existing rough balance of the earth's incoming and outgoing heat. The considerable increase in atmospheric temperature will cause a fast melting of mainland glaciers and a perceptible rise in the level of the world ocean with all the attending unfavourable consequences.

To preclude such a course of events or at least to stave them off it is necessary to prevent the saturation of the earth's atmosphere with carbonic acid. According to experts, in recent years man's economic activity has been generating about five thousand million tons of carbonic acid annually, which is discharged into the atmosphere. About one half of it ultimately finds itself on the ocean bed as a result of the natural cycle, while the second half raises the CO_2 constant in the earth's atmosphere.

Carbonic acid resulting from man's activity forms mainly through the combustion of fossil fuels (coal, oil, gas, etc.). Consumption of fuel is growing at a constant and fairly rapid pace. The only exception was a short period in the '70s when consumption diminished somewhat as a result of a sharp rise in oil prices. Incidentally, the energy crisis showed that the power consumption of public production per unit can be brought down sharply.

The balance of carbonic acid in the earth's atmosphere also depends on its consumption by plants. By assimilating atmospheric carbonic acid in the process of photosynthesis plants turn it into a primary biomass that feeds all other living matter on earth. The consumption of carbonic acid is especially intense in tropical rain forests. Regrettably, over the years the latter have been destroyed, devastated both for the sake of timber and new farm land. A considerable part of carbon dioxide is consumed by ocean flora. Recently, however, an intensive pollution of sea and ocean surface is in progress, which reduces the absorption of carbon dioxide.

In absorbing carbonic acid, plants simultaneously produce oxygen, and in the process of turning carbon dioxide into biomass, release oxygen and return it into the atmosphere.

What has been said above goes to show that the problem of the greenhouse effect is enormous and complex. Any further combustion of fuels, as well as the destruction of vegetation exacerbates it. This problem backs up the positions of those who advocate the accelerated development of nuclear power engineering, since commercial nuclear power plants do not increase the amount of carbon dioxide in the atmosphere.

In terms of the greenhouse effect, it is extremely important to reduce the consumption of fuel in producing goods and services. Better-insulated houses, lower-capacity cars, alternative energy sources (the energy of the wind, the sun, water power, etc.) - all of these are important ways to combat the greenhouse effect, i.e. to maintain an environment friendly to man and humankind.

4.1.4 Radioactive contamination of the environment

The development of atomic and, later, nuclear weapons, the wide use in the national economy of "the peaceful atom" have created a new formidable environmental threat to the human race.

Until recently, a nuclear war was regarded to be the main danger associated with it. The elimination of the stand-off between the two military political blocs has put this danger on the back burner, especially against the background of the long-term effects of the nuclear explosion at the Chernobyl power plant in April 1986.

Moreover, in the past few years it has become clear that there can be no winners in al all-out nuclear war: the survivors of a nuclear explosion and radiation are bound to die in the so-called "nuclear winter", when the earth's surface temperatures will fall dramatically because of thick clouds of smoke and dust which form as a result of nuclear explosions and fires caused by them. The situation in Kuwait that emerged following the war in the Gulf, when hundreds of oil wells were set on fire, can be regarded as a model simulating nuclear war. A drastic fall in temperatures under the thick layers of smoke was reported in the press.

It is more important to consider the situation taking shape as a result of the radioactive pollution of the environment following the testing of nuclear weapons, "peaceful" explosions, accidents, poor storage of radioactive wastes, negligence in storing radioactive material ... Nuclear testing started in the '40s and was conducted first by the U.S.A. and the USSR and then also by France, the United Kingdom and China. According to various data, including the reminiscences of those who participated in the testing, among them designers of nuclear weapons, radioactive danger was grossly under-estimated in the first few years. Furthermore, everything in the this field was strictly classified, so that many events of the '50s became known to the general public only in he second half of the '80s in conditions of "glasnost". total secrecy (classification categories "secret" and "top secret"), and semi-secrecy (classification category "to be used by the staff only") were among the most important causes of the "civil" population being totally unprepared for nuclear accidents, while specialists and other workers at nuclear facilities were far from being ready for them.

Thus, quite recently, in connection with the fifth anniversary of the Chernobyl disaster, it was reported in the media that as far as back as 1969 instructions regarding radioactive leakage were worked out. The Chernobyl nuclear power plant also had them, but they were virtually unknown to most people. That is why in the first hour and days following the reactor explosion, elementary, but fairly effective, measures protecting people from radiation failed to be taken. Thus, the population was not provided with iodine preparations which would have prevented the accumulation in the thyroid gland of radioactive iodine which, in the first period following the explosion, was one of the main radioactive hazards. The light-minded attitude to radioactive danger is well illustrated b the fact that Kiev, situated not far from Chernobyl, was the venue of the traditional May Day march-past which brought vast numbers of people out into the street, although Kiev was affected by radioactive contamination and radioactive levels were rather high.

The scale of the Chernobyl disaster was perhaps only vaguely known, but the little that was known was withheld from the public. While clearing up the accident and its consequences many people involved in this process suffered because of lack or inadequacy of protective equipment, information, radiation counters, etc. The first news of the Chernobyl disaster came from Sweden. The scale of radioactive contamination - radioactive fallout affected Ukraina, Belorussia and Russia - was for many years kept under wraps; new unseemly facts keep coming to the surface. Characteristically, five years later, "Prosecutor-General of the USSR started legal proceedings against officials who abused their power and failed to perform their duties in coping with the consequences of the Chernobyl disaster" (Izvestia, May 8, 1991, issue No. 109, Moscow evening edition, p. 1). As officially recognized now, the nuclear reactor itself was imperfect, protective measures to prevent or minimize the release of radioactivity, which are routine at nuclear power plants in other countries, were not provided for.

Five years after the disaster, the Supreme Soviet was forced to adopt a special resolution on the elimination of its consequences chiefly because the previous resolution was not implemented.

Air currents broadcast radio nuclides all over the world. this is what happened after the Chernobyl disaster. "The explosion blew up at 01:23 on April 26, 1986 ... The wind was weak, south-eastern. The radioactive cloud started moving towards Scandinavia. A higher radioactive level was registered there on April 27. Twenty-eight hours later the cloud crossed the border of Finland, entered the area dominated by the Novaya Zemlya - centered anticyclone and was blown by it. Part of the cloud and its train reached the northern parts of the USSR, while the other part caused higher radioactive levels in Norway and Sweden on April 28. By May 1 the new radioactive cloud reached Denmark and spread over all the countries of central Europe. Paris recorded the highest radioactive level on May 2. The same day, on entering the low-pressure area over Iceland, the cloud reached the British Isles. As ill luck would have it, it was raining over Britain, and, of course, the rain became contaminated. Then, carried by the cyclones, the cloud reversed its course. On May 3 a higher radioactive level was registered in Japan (the island of Honshu), more than eight thousand kilometers away from he place of the release. Evidently, the train of the main radioactive cloud had been carried by the wind at an altitude of medium tropsphere. Its speed may have reached 100 kilometers per hour. This eastern part of the cloud and its train crossed the Pacific and the Atlantic, merely brushing against US territory and reaching Europe, thus making a round-the-world trip. Even in the U.S.A., which was only slightly affected, 120 more deaths are expected, if over a long term".

Radioactive isotopes travel with surface and underground water streams, are consumed by plants and animals and then by humans, the concentration of radioactive nuclides in each link of the "food chain" may go up manyfold.

Negotiations on a nuclear test-ban treaty were held for a long time in the cold war years. A treaty banning testing in three spheres (in the air, on the surface, and under water) was signed in Moscow in 1963. However, testing has not been discontinued completely. Over the long years of weapon testing, as well as testing for "peaceful purposes", a global radioactive contamination of the biosphere has taken place, which has resulted in constant radiation exposure of practically the entire population of the globe. As for the long-term effect of nuclear explosions on men's health, the figures of permitted doses of radiation were set at higher levels than today. It was only after a protracted series of atmospheric testing that the real size of danger and authentic data concerning the spread of radioactive fallout were established: the true importance of radio-biological chains which are responsible for the radio-isotopic saturation of the ecosphere was also discovered" (see: Kapitsa S.P., Mastering a new way of thinking; in: "Cybernetics, the biosphere and the problems of peace", Moscow, 1986, p. 136).

Radioactive radiation is especially dangerous and treacherous since small doses do not produce any visible changes in individual health. It has been established, however, that there is no such thing as harmless doses of radiation, that any measure of radiation raises the likelihood of oncological disease and affects heredity. It is also now established that the presence of chemical substances in the environment may considerably heighten the carcinogenic capacity of radiation, the combined effect being especially powerful in situations where small doses of radiation operate in the presence of small concentrations of chemical carcinogens.

It is now generally recognized that there are no absolute guarantees against accidents at nuclear power plants. The Chernobyl "accident of the century" has brought about a radical change in the attitude of the general public towards nuclear power engineering. The construction of many new nuclear power stations and new reactors at operating stations has been suspended on the territory of the former USSR, a number of power stations (Yerevan) and reactors having been shut down. The Chernobyl tragedy has given a boost to the green movement in the country. Currently a tough fight is in progress between "the greens" and "the reds" on the future of nuclear power. The proponents of nuclear power engineering accuse the greens of radiophobia. Here is what an ardent supporter of nuclear power has to say:

"It is highly regrettable that due to a combination of reasons a certain part of the population has developed a condition which is connected with a general and constant fear of the adverse effect of radiation on their health, unrelated to any specific doses. I have termed this condition "radiophobia", i.e. a fear of ionizing radiation as such, without any good reason" (see: Ilyin L.A. in: Chernobyl: events and lessons", Moscow, 1989, p. 178).

The main cause for radiophobia is constant deception, withholding information and lack of the simplest radiation counters.

The terms of operation of the first nuclear power plants with a life span of 30 years are nearing completion. Meanwhile, the problem of the disposal of reactors, other nuclear equipment, unused fuel, has not been solved.

There is less enthusiasm towards nuclear power engineering practically everywhere in the world. The number of construction projects is decreasing, some countries opting to build no more power stations, others deciding not to build a first nuclear power station. Sweden will shut down all its nuclear power stations by the year 2010.

However, the radiation accumulated in the ecosphere to date poses a serious problem, since the radioactivity of many radio-isotopes is decreasing very slowly. The world will pay a high price in terms of many early deaths and more genetic deformities for its infatuation with "the peaceful atom", for the light-minded attitude to the hazards it entails.

4.1.5 The loss of gene pools

Experts believe that biological species have recently been disappearing at a pace unparalleled in history.

"Many ecosystems that are rich biologically and promising in material benefits are severely threatened. Vast stocks of biological diversity are in danger of disappearing just as science is learning how to exploit genetic variability through the advances of genetic engineering" (Our Common Future, p. 148).

Genetic variability within species is also decreasing rapidly, i.e. the number of species and varieties inside species, as well as the genetic variability of species, are decreasing, lowering their capacity to adapt to the changing environment. Thus, "the remaining gene pools of major crop plants, such as maize and rice, amount to only a fraction of the genetic diversity they harboured only a few decades ago, even though the species themselves are anything but threatened" (Our Common Future, ibid.).

As long as life has existed on earth, biological species have always vanished according to specialists. The average life span of a species, is about five million years. It is believed that in the past, in the course of hundreds of millions of years, a species a year disappeared on average. Now the pace has accelerated a thousandfold. There are no exact data on the rate of disappearance of species since, in the main, little known, or unknown species disappear, for instance, insects in tropical forests.

The disastrously accelerating disappearance of species stems from man's activity, especially the destruction of tropical rain forests. Covering a mere 6% of the earth's surface, these forests account for more than half of the world's species of plants and animals.

The graphic example is given below of the unfolding changes in this part of the world, borrowed from the Brundtland Commission Report.

Until the middle of this century Madagascar had about 12,000 plant and 190,000 animal species, most of which were endemic, i.e. did not exist elsewhere. Scientists estimate that at least half of the original species have already disappeared or are on the point of doing so (See: Our Common Future, p. 149) as a result of the destruction of the greater part of the rain tropical forests on the island.

Biocoenoses of tropical forests are the most power absorbers of carbon dioxide ad producers of oxygen on the earth, i.e. powerful stabilizers of global conditions of life on the planet; however, this aspect has been considered in the sector devoted to the greenhouse effect. Here they concern us only as guardians of the gene pools.

By the mid-'80s, mature tropical forests covered only 0.9 billion hectares, although formerly they covered 1.5-1.6 billion hectares (Ibid., p. 151). According to experts, every year sees the destruction of anywhere from 7.6 to 10 mln hectares of these forests, while another 10 mln hectares are grossly disrupted annually (the figures of the late '70s).

The bulk of the tropical forests lies in Amazonia. Their territory is rapidly dwindling. "If deforestation were to continue in Amazonia at present rates until the year 2000, but then halted completely (which is unlikely), about 15% of plant species would be lost" (Ibid.).

About 40% of all biological species of the earth are found in the forests of Latin America outside of Amazonia, in Asian and African forests bordering on the Zaire basin. All these forests are threatened with extinction, and their disappearance may result in the death of hundreds of thousands of biological species (Ibid.).

The general conclusion experts raw from he dynamics of tropical rain forest landscapes is as follows: "Unless appropriate management measures are taken over the longer term, at least one quarters, possibly one third and, conceivably, a still larger share of species existing today, could be lost" (Ibid., p. 152).

The main reason for the rapid destruction of tropical rain forests lies in the economic backwardness of the countries in this part of the world and the poverty of their population. Rapid population growth calls for an equally rapid expansion of agricultural production, while the extremely backward extensive agriculture needs more farmland, into which tropical forests are turned.

On the other hand, wide-scale and fast-expanding forest clearing is carried out, the right to which is acquired by concessionaires at very low prices, which "constitute but a small part of the net commercial value of the timber harvest" (Ibid., p. 153).

Here we observe the closest possible ties between ecology and economy. The great global environmental role played by the rain tropical forests warrants, as we see it, the economic involvement of the world community, above all of the rich industrialized countries who discharge into the atmosphere vast quantities of carbon dioxide which is largely absorbed by tropical rain forests. On the other hand, the industry of these countries consumes a great part of the oxygen produced by these same forests.

It seems necessary to give strong economic support to the countries on whose territories tropical rain forests are situated, "to pay" them for the preservation of these forests, to provide them with food produced in other parts of the world.

Loss of plant and animal species of the kind observed in the ecosystems of tropical rain forests goes on all over the world where there is life in one form or another, although usually

on a smaller scale. However, this loss is also extremely important since the inhabitants of different natural zones possess very important genetic peculiarities which enable them to adapt themselves to vastly different conditions of habitation; the heat and aridity of the deserts of the temperate zone, the hard frosts of the Arctic tundra, etc.

The genetic resources of the earth are virtually the property of all the peoples of the world, irrespective of where the given species dwells. Thus, to quote but the simplest and well-known examples: the world corn crop depends on the genetic resources of wild corn in Mexico and Central America, the productivity of cocoa plantations in South America and Western Africa is maintained by the genetic resources of forests in Western Amazonia, while the production of coffee is determined by the gene pools of the Ethiopian wild coffee tree (Ibid., p. 159).

Most probably, the preservation of all plant and animal species on earth and their clusters will, in the near future, become the concern of international politics since they will be regarded as factors benefiting all people living on earth. The realization will come that the preservation of the forests of Amazonia, for example, or the coral reefs of Australia, will serve the interests not only of the peoples of Brazil and Australia, but also the population of the U.S.A., all the countries of Europe, Japan, etc.

Although many countries now have national programmes on the rational utilization and preservation of animal and plant resources, practical progress in preserving the gene pools is comparatively modest. The processes of the destruction of eco-systems and the disappearance of biological species, their sub-species, varieties and races proceed at an accelerating pace. The major factors contributing to the destructive process are:

(1) economic backwardness and poverty which necessitate the destruction of natural landscapes to produce food to assuage hunger;

(2) the growth of industrial production in the developed world, consuming increasingly more biological resources at home and, especially, of the developing countries, as well as the common property of the peoples of the world - the world ocean and the Antarctic, and also discharging into the atmosphere ever greater quantities of industrial effluents and the polluting wastes of the sphere of services (transport, etc.).

To radically slow down the rate of destruction of bio-coenoses, the loss of biological species and the reduction of the gene pools, it will be necessary to convert considerable parts of territories in all natural zones into reserves. Quite a few countries in possession of the richest fauna and flora will be unable to accomplish this unless they receive liberal external assistance. We need a world programme to defend the earth's biosphere, which should be financed by the industrialized countries who are more responsible for harming the planet than

others. The remarkable "Man and the Biosphere" programme devised by UNESCO deserves further development and should be included in general environmental courses for university students.

According to the Brundtland Commission, the essence of the problem of preserving biological species lies in the fact that short-term economic interests of separate countries more often than not run counter to the long-term interests of sustainable development and the potential economic benefit of the world community as a whole. Therefore, in preserving genetic diversity, special attention should be paid to making it economically more attractive both in the short term and over a longer period, with a view to protecting species and their ecosystems. The developing countries should get a fair share of the economic benefits obtaining from the commercial use of genes.

This seems to be true, but insufficient, as clearly follows from the same Brundtland Commission report. Thus, for example, Kenya has allotted 6% of its territory to national parks and reserves to protect its wild life and to earn foreign currency through tourism. But Kenya's population is so vigorously advancing on the parks that protected lands are steadily taken over by the advancing farmers. It should be taken into account that forecasts indicate that the population of the country, is to grow four times over the coming 40 years (Ibid., p. 153).

Can a "fair share of the economic benefits obtaining from the commercial use of genes" be enough in such and similar situations for the preservation of ecosystems, biological species and genetic variability? The preservation of the environment is a very costly business. The main part of resources should come from those who possess them, i.e. industrialized countries. Otherwise, the rapid destruction of the gene pools will continue, and the developed world will eventually lose much more than the cost required for the preservation of the earth's gene pools today.

4.2 Regional problems

A few examples of regional environmental problems

There are far more regional than global problems in the world, for example, the desertification of sub-Saharan Africa, acid rains in Western and Central Europe, the problems of the Mediterranean, Black and Caspian Seas, and the environmental disaster of the Aral area ... .

By way of example, let us briefly consider three of them, familiarization with which will allow us to acquire the kind of knowledge required by the criteria dealt with in Sections 3.3, 3.4, that determine the selection of environmental content for general higher education. We mean, specifically, the criteria discussed under the heading "Objectives as Criteria" and "The Criterion of Environmental Ethics" (Section 3.3), and "Adequate Reflection of Basic

Concepts" and "The Combined Ecological, Socio-Economic and Socio-Cultural Dimensions" (Section 3.4).

4.2.1 The Black Sea

One of the main peculiarities of this water basin jutting far into the continent very remote from the Atlantic to whose system it belongs, consists in the fact that life there exists only within a comparatively thin surface layer of the water (150-200 meters, and, according to the latest data, even thinner), while the water below is poisoned by hydrogen sulphide. Water exchange between the Black and the Mediterranean Seas, the Black Sea water being lighter and less mineralized (the Black Sea water has only half of the salinity of the Mediterranean Sea water), while the water flowing from the Mediterranean is heavier and deeper. The Black Sea collects water from a considerable part of Europe, including the European part of the former USSR. Europe's second largest river, the Danube, and third-largest river, the Dniepr, which is Ukraine's largest river, as well as smaller rivers, flow into the Black Sea. The Black Sea has a surplus water balance.

Over the past few decades, the state of the Black Sea has been approaching a disaster, which is the immediate concern to all the countries possessing parts of the coastline: Turkey, Bulgaria, Romania, Ukraine, Russia and Georgia.

Firstly, the fish productivity of the Sea fell, the most valuable kinds of fish disappearing partially or completely, beginning with the sturgeon family.

Then the north-west shallow section of the sea, into which flow the major tributaries became overgrown with duckweed, which attests to mass proliferation of blue and green algae in its poorly mineralized water. This caused a sharp drop in the content of water oxygen which is absorbed by the decomposing algae.

Finally, information emerged that the borderline between dead and live water is rapidly rising, the level of hydrogen sulphide is rapidly growing (the information is contradictory; different sources quote different levels at which the borderline between dead and live water stands, and different paces of its elevation).

Various suggestions have been made on improving the ecology of the Black Sea, including radical ones: to rid the sea water of hydrogen sulphide. The press even reported preparatory work to set up a specialized mammoth facility to process the entire volume of this huge water reservoir. However, the knowledge of the essence of the problem and of the ways of its possible solution is far from adequate. Opinions were also aired in the media that the proposed "purification" of the sea of hydrogen sulphide could lead to an environmental disaster.

Wherein do the reasons for the environmental deterioration of the sea lie?

The major reason seems to be the pollution of the rivers flowing into it.

In the former Soviet Union there was a gigantic project to redirect part of the flow of the lower Danube into the Dnieper, whilst irrigating the fertile, but arid, steppes of the South of Moldavia and Ukraine. This began to be translated into reality. However, it soon proved that the Danube water is unfit for the purpose, being too contaminated, and carrying an impressive "bunch" of pollutants: the salts of heavy metals, phenols, oil products and many others. In the opinion of many experts who addressed this question in the press and at scientific conferences, the use of such waters for irrigation is extremely dangerous environmentally . It should be noted that the degree of pollution of the Danube waters is constantly and rapidly rising. The Danube flows through many countries, each of which contributes its share to pollution.

The Dnieper is heavily polluted. For the past several decades its waters have been overgrown with duckweed, particularly the water reservoirs of its numerous hydro-electric power stations. This means that very large quantities of nitrogen and phosphorus enter the river. It is precisely these substances that cause the northwest area of the Black Sea to become overgrown with weeds.

It is exactly in the basin of the Dnieper that the Chernobyl catastrophe took place. In principle it is quite inevitable that radio nuclides should flow downstream, though their proportion is still unclear; they can accumulate in food chains; part of them is bound to end up in the sea.

The concentration in the Dnieper of various kinds of other pollutants is unknown (information of this type was classified in the USSR, even if it is undoubtedly considerable).

Preventing an environmental catastrophe in the Black Sea and keeping it in a more or less satisfactory condition (that would make it possible to use its bioresources, its numerous health resorts with their beaches, etc.) requires improving the environment on the territories of many countries.

The problems of the Black Sea call for an in-depth study, since experts disagree on many of the important ecological aspects.

4.2.2 The Sahel environmental disaster

Sahel, the southern fringe of the world's greatest desert, the Sahara, stretches form the Atlantic coast in the west, i.e. from Mauritania and Senegal through Mali, Upper Volta, Niger and Chad, to the Sudan. This is a broad band of land from 300 to 500 km wide in some places, over 4 mln. sq. km in area.

Sahel is partly a semi-desert, partly desertified savannah. The one feature common to this vast area with otherwise a lot of local differences is extremely low rainfall which makes it drought-prone. Average rainfall varies annually from 100 mm in the regions bordering on the Sahara, to 600 mm in the extreme south and in the east. With high daily temperatures, water loss through evaporation may considerably exceed levels of rainfall, mostly occurring in the short summer season. Besides, average rainfall varies greatly from year to year.

Economically, Sahel is one of the world's least developed regions. It covers parts of agrarian countries that are in the initial stages of urban development. Their population s engaged in pastoral livestock breeding, whose relative well-being is heavily dependent on the condition of natural pastures.

In the late '60s and early '70s Sahel experienced a severe drought that resulted in a sharp drop in the number of livestock and a famine that took a heavy toll on life and caused a massive exodus of the population to the more environmentally friendly southern regions. Sahara's boundary moved 100 to 200 km south, with the respective shift of the southern border of Sahel. Thus the semi-desert took over the desertified savannah, which in its turn, claimed a part of the savannah proper.

What actually happened was the destruction of the natural bio-coenoses upon which the traditional local economy depended. Most researchers agree that the Sahel disaster was the result of combined natural and socio-economic factors, but they are divided on their relative weight - some give priority to the global meteorological processes that brought about the drop in precipitation; others, on the contrary, to antropogenetic, or human-induced factors, like the adverse effect cattle breeding has on natural bio-coenoses.

Sahel has also witnessed other droughts this century, the most disastrous being those of 1913 and 1944. But the 1968-1973 drought that culminated in 1972, the longest and most severe of all. In 1968, in Mali's region of Gao, rainfall totalled 256 mm; in 1971, 173 mm; in 1974, 128 mm; and in 1975, 307 mm. Correspondingly the number of cattle (more susceptible to lack of water than camels, goats and sheep) plunged from 1,800,000 in 1970 to 384,000 in 1974.

Researchers believe that Sahel's traditional subsistence pattern (pastoral, predominantly nomadic and semi-nomadic livestock breeding) was very well adapted to the harsh semi-desert environment. Its natural bio-coenoses were extremely well-balanced, and any adverse effects of droughts were usually compensated for with periods of increased rainfall.

In the past decades, the situation has changed dramatically. With the growth of population the number of livestock also went up. The pressure of natural pastures increased over what the bio-coenoses could sustain; the best forage grasses became extinct, pastures and water-places became depleted or totally devastated. Moreover, more land was taken up by dry

farming, preferably on the more productive former pasture land. The situation was aggravated by the spread of irrigation farming, especially in river valleys, formerly used as pastures in arid seasons.

The growth of population, and the number of cattle, as well as changes in agricultural patterns, disrupted the balance between the environment and peoples' needs. The natural ecosystems collapsed under antropogenetic stress.

The gradual decline in vegetation growth triggered off wind erosion. Fine earth was blown away, with a resulting drop in soil fertility and further decrease of vegetation, i.e. forage grass per unit of area, intensified grazing and, finally, to irreversible devastation of pastures and a greater wind erosion, and so on.

Water erosion also increased. Sahel's scarce rainy season occurs mostly through heavy seasonal downpours, that form surface streams draining into powerful run-offs that flush away the topsoil and erode the landscape, which process is intensified by the gradual depletion of vegetation.

Eventually, a semi-desert in northern Sahel gave way to barkhanes and was thus totally desertified.

In the more humid southern Sahel, the natural environment was most seriously affected by utilization of scrub and tree growth for firewood needed in greater amounts by the ever-increasing local population and by their setting fire to the previous year's grass.

Most scientists agree that human activity was instrumental in desertification (i.e. increase in the area of the desert at the expense of the adjoining territories), natural factors playing a minor role. This point of view is supported by the evidence of desertification in the ex-Soviet Union, Central Asia and some other regions. One example is a comparatively small desert in Kalmykya, a region on the right bank of the Volga; it increased in area over a period of stable growth of annual precipitation. Factors at work here are the same as in the Sahel, that is, antropogenic pressure and overgrazing.

The extent of desertification on our planet is truly great. In the 1970s, an estimated 60,000 sq. km. of pasture and productive farmland became desertified. (Geogr. Encylop. Dict., Moscow, 1988, p. 212). The process is most pronounced in Africa.

It is generally believed that desertification can be effectively countered. The problem, however, is that countries most heavily affected by the process are comparatively poor and less developed, and do not, therefore, possess the necessary resources. Countering the desertification should be regarded as a priority task by the world community as a whole.

Understanding the nature, causes, and mechanism of the desertification process is an important prerequisite for fighting it. Examples abound of the increased man-induced stress devastating the environment just because man is not aware of the consequences of his actions.

4.2.3 The Aral environmental catastrophe

This is a large-scale and demonstrative and, therefore, valuable illustration of what might result from systematic, ill-considered, massive intrusion into the course of natural processes.

For thousands of years, civilizations existed highly developed for their time in the Arab Sea basin, whose life was based on irrigated farming, covering entirely or partially the territory of five states of Central Asia. There was more or less stable equilibrium between man and nature. This equilibrium has been upset and destroyed before our very eyes into past three decades.

A huge expansion of irrigated lands began in the Aral Sea basin in the '60s, mainly for the sake of cotton growing. The two Central Asian rivers, the Syr Darya and the Amu Darya, great both in their length and their role in the life of the peoples living in that area, if not in the water flow, have been rapidly and almost entirely devoured by irrigation needs.

The average annual subsurface flow in the Aral basin (the territory of almost the whole of Central Asia and part of Kazakhstan, amounting to about 1.5 million square kilometers) is nearly 127 cubic kilometers (the above-mentioned rivers as well as some smaller ones). Until the early '60s, about one half of this water flowed into a huge lake - the Aral Sea - with a water area of 66,000 square kilometers. The expansion of irrigated lands and the wasteful use of water, which was free of charge for consumers, reduced its flow into the sea. Over the past three decades, the sea level has dropped by approximately 14 meters and its volume of water has dwindled twofold from 1,000 to about 400 cubic kilometers. Some 30,000 cubic kilometers of the sea bed have been freed from water and turned into a salt desert, from whose surface salt dust is carried by winds for hundreds of miles around, causing enormous damage to agriculture.

The lower Syr Darya and Amu-Darya have been badly hit by desertification. The territories of flood-land forests previously inhabited by a variety of fauna, including deer and even tigers, have shrunk considerably, until practically non-existent. Water-meadows and water weeds have also dwindled. Fodder stocks for animal husbandry have sharply diminished. The bio-coenoses previously existing here have gradually been overtaken by desert, with extremely scanty vegetation.

A lower erosion basin (the level on which the water flows) has brought about a narrowing of the channels of the rivers, streams and streamlets flowing into the Aral Sea,

which, in its turn, resulted in lower levels of subsoil waters and corresponding changes in vegetation deprived of moisture.

In point of fact, the Arab Sea has turned into a dead reservoir since the salinity of its water has risen 2.5 times and the former water fauna and flora failed to adapt themselves to the new salinity level. One of the richest fish reservoirs of the region has ceased to exist. The inhabitants of the area previously engaged in fishing, fish processing and water transport have lost their jobs and moved elsewhere.

The climate of the areas adjacent to the Aral Sea has changed greatly: winters have grown colder and summers hotter (water has a high heat capacity, and the presence of a vast reservoir in the desert has made the climate milder).

But the most important, perhaps, is that the population of the vast territories adjacent to the Aral Sea has lost its comparatively pure drinking water. What water is left in the lower Syr Darya and Amu-Darya is now heavily polluted with unprocessed effluents flowing into the rivers from the fields and towns, and containing fertilizers, pesticides, phenols, oil products, heavy metals, etc. This water is practically unfit for consumption, ad there is no other water in those parts.

Health has deteriorated badly, with a sharp increase in the incidence of kidney trouble and general diseases of the alimentary canal; many instances of in-born deformities have been registered which, in the opinion of experts, are caused by the chemical properties of the water consumed; infant mortality is extremely high, in some regions exceeding 100 deaths per thousand in babies under one year.

The main brunt of all these misfortunes fell on the population of the Kzyl-Orda region of Kazakhstan, the Kara-Kalpak Autonomous Republic, the Khorezm region of Uzbekistan and the Tashauz region of Turkmenistan, totalling about 4 million people. The same misfortunes have afflicted, though to a lesser extent, practically the whole of the Aral basin, with its population of approximately 35 million.

So far, the projects devised to eliminate the consequences of the Aral catastrophe hold o promise of speedily saving the population of this area from the misfortunes that have befallen them.

4.3 Bright spots on a dark background

The global environmental trends are unfavourable. No well-informed individual has any doubt about it now. Today the possibility of exerting a positive influence on some environmentally hazardous processes (such as carbon dioxide discharge in to the atmosphere) are insignificant. In many other respects, however, for example, in cases of environmental

pollution on a local scale they are quire considerable. There are quite a few instances of a rapid and radical improvement of the environmental situation in certain areas caused by the growing awareness of the real dangers of environmental pollution and a powerful mass environmental movement.

Thus, the cleaning of North America's previously heavily polluted Great Lakes has taken place.

The waters of the Rhine have become much cleaner over the past few decades, so that some fish species have returned.

In a number of cities of the former Soviet Union the air has become much cleaner as a result of stricter observance of anti-pollution regulation by industrial enterprises, as well as discontinuing operations harmful to the environment (e.g. plants producing protein vitamin concentrates).

The most illustrative example attesting to the great potential of humanity today is that of Japan, a whole country having achieved a drastic improvement of its environment over a short space of time. The atmosphere in its major cities, previously heavily polluted, has become much cleaner.

To solve the earth's environmental problems, to prevent the environmental crisis turning into an environmental catastrophe is only possible if there is scientific and technological progress, and a mass environmental movement.

The main environmental achievements in Europe over the past few decades are linked to mass environmental movements, with the actions of "the greens". In a number of countries, political "green" parties have been set up; programmes of major political parties now include environmental goals and tasks.

In the past few years, the former Soviet Union has seen intense mass action against specific environmentally hazardous industrial enterprises (rallies, strikes, demonstrations). They resulted in the closing of a nuclear power station in America built in a densely populated earthquake-prone valley, in halting the construction of a number of nuclear power stations, and new power units at functioning nuclear power stations, in abandoning a number of highly-polluting obsolete coke-producing plants, etc. Here the close interconnection between ecology and economy has once again made itself felt. Many environment-hostile production facilities are difficult to eliminate for economic considerations; some of the enterprises previously closed, had to be put into operation again.

In principle, strong possibilities exist of improving the environment locally.

It is common knowledge that, in many cases, the main pollutor of the atmosphere in cities is private transport. However, the degree of environmental harmfulness of cars varies greatly, and depends on many circumstances: the type of fuel, the perfection of the engine, on how well it functions, the condition of the roads, etc. Different countries set different norms concerning automobile exhaust fumes. In the industrialized countries of the West they are stricter than, for instance in the former USSR.

In many major cities, the use of petrol with lead additives is prohibited.

A well-developed public city transport service could noticeably reduce the overall use of automobiles and, consequently, the level of atmospheric pollution.

It is possible to effect a large-scale transfer of motor transport to fuel which is less of a pollutant than petrol (natural gas) or to environment-friendly fuel (spirits).

And finally, there are great hopes for an electromobile, that would be convenient in every respect, and capable of competing with an automobile.

Growing ecological awareness of the general public has led to mass production of health foods, better water purification, and industrial production of bottled drinking water which is delivered to consumers (factories have been and are being built, in particular, in the states of Central Asia to supply clean drinking water to the population having suffered from the Aral environmental catastrophe).

New production technologies and more effective purification facilities can drastically reduce the amount of harmful discharge per unit of useful production. Particularly impressive are the results achieved in fuel saving as a result of the energy crisis in the '70s.

At present, it is still possible to succeed in an appreciable improvement of the environment at a local level against the background of global environmental deterioration. But this can be accomplished through much greater outlays on environmental protection. Usually, scientific publications claim that to maintain a satisfactory environmental situation in the country it is necessary to spend from 5 to 6% of the gross national product. Specifically, it is claimed that this is exactly the share allotted for these purposes in environmentally safe Japan, whilst before it was only about 1% of the GNP.

Lately, world prospects for environmental protection have increased radically, due to the ending of the confrontation between the two military-political blocs, and the cold war; consequently a considerable share of military expenditures can be transferred to the needs of the environment.

There is reason to believe that global environmental threats to the world can be averted through further scientific technological and socio-economic progress of the world community.

IN GUISE OF CONCLUSION

The time that has elapsed since the Stockholm Conference is marked by significant efforts to promote the awareness amongst various groups of population and different social and professional categories of the vital necessity to put an end to irresponsible attitudes towards the environment and to badly pondered decisions and actions which might eventually disrupt the equilibrium of nature having taken millions of years to establish. The problem as it stands now concerns not only protection of the environment, but also reestablishment as much as possible of the balance that has been disrupted, and to significantly improve the environmental situation.

From the very start, measures to promote and to develop environmental education at all levels within both formal and non-formal education systems played an important part in these efforts.

The United Nations Conference held in Rio de Janeiro in June 1992 on Environment and Development adopted a detailed programme of action called "Agenda 21" which, according to the Conference itself, "addresses the pressing problems of today and also aims at preparing the world for the challenges of the next century." (see: Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992. Doc. A/CONF.151/26 (vol.1). 12 August 1992, p.15, para 1.3).

The "Agenda 21" contains a special chapter concerning education and training based, as underlined by the Conference, on the Declaration and Recommendations adopted by the Tbilisi Intergovernmental Conference on Environmental Education.

The fact of singling out education and training issues into a separate Chapter emphasizes their vital importance in the resolution of environmental problems and in the promotion of sustainable development. The Rio de Janeiro Conference stressed the critical importance of education for improving the capacity of people to address

environment and development issues (see ibid., Vol. III, 14 August 1992, page 70, para. 36.3). At the same time pointing out that the recommendations contained in this Chapter are based on the Declaration and the Recommendations of the Tbilisi conference, it confirmed the fundamental importance of the general concept, objectives and aims as well as the principles governing environmental education, which had been defined in these documents.

The "Agenda 21" contains a number of specific recommendations concerning higher education. Referring to some issues of the content of higher education, *inter alia*, the Rio de Janeiro Conference proposed to introduce cross-disciplinary courses common to all students. It also put forward the idea to reinforce existing centers of excellence, or to create new ones, which would carry out interdisciplinary research and education on environment and development, as well as on law and management. Universities and existing networks might become such centers of excellence, stated the "Agenda 21" (see ibid., p.73, paras 36.5 (i) and (j)).

Apart from measures directly related to higher education, practically all other provisions concerning various levels of education adopted by Rio de Janeiro conference, also have a bearing, in one way or another, on higher education. For example, "Agenda 21" proposes to up-date or to prepare a strategy aimed at integrating environment and development as cross-cutting issues into the curricula at all levels of education within the next three years. At the same time it raises the question of a radical revision of existing curricula in view of adopting a multidisciplinary approach to the problems of environment and development including their socio-cultural and demographic aspects (see ibid., p.72, para 36.5 (b)).

The central element of this issue is the question of the content of education, its multidisciplinary nature and its definition. The most effective way to deal with this issue is certainly through direct - and one would say - decisive participation of universities and other higher education institutions of this type. It is indeed these institutions which do

teach and carry out research in the widest possible array of scientific disciplines. They also possess highly qualified staff with experience of teaching and research necessary for curriculum development and for ensuring the multidisciplinary character of the content of education. As a matter of fact, higher education institutions have long played a key role in defining the content of general environmental education not only for themselves, but also for the pre-university educational institutions. They will have to continue this activity both to satisfy their own needs and to meet the needs of various levels and forms of education. It is evident, of course, that because of the "multiplying effect" in society of university graduates, which was mentioned in Chapter 3, the success of raising environmental awareness, promoting environmental ethics and environmentally sound behaviour of various groups of population depends in the long run to a very large extent on the quality of general environmental education provided to all university and other higher education institution students in all fields.

This underscores the importance of the content of such an education. Its definition needs well-pondered initial criteria. Work on this issue is now in its first stages. It might be expected that the Rio de Janeiro Conference and "Agenda 21" will give new impetus to this work, thus helping to speed-up and deepen it.

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